Tax-Benefit Models and Microsimulation Methods

Author:
Bradbury, Bruce

Publication details:
Working Paper No. 87
Reports and Proceedings
0733400922 (ISBN)

Publication Date:
1990

DOI:
https://doi.org/10.26190/unsworks/1025

SPRC REPORTS AND PROCEEDINGS
No. 87 December 1990

TAX-BENEFIT MODELS AND MICROSIMULATION METHODS

edited by

Bruce Bradbury

Proceedings of a Workshop
held on 1 June 1990
at the University of New South Wales

ISSN 0159 9607
ISBN 0 7334 0092 2

Social Policy Research Centre
The University of New South Wales
P O Box 1 · Kensington · NSW · 2033 · Australia

FOREWORD

The Social Policy Research Centre from time to time sponsors Workshops on topics of specialised interest to those involved in social research and policy analysis. Whenever possible, the proceedings of these are published in order that the wider social research community may benefit from the papers and discussion presented at the Workshop. The subject matter of this Workshop is becoming of increasing importance to the analysis of income distribution, poverty, living standards and tax incidence, as well as to assessment of tax and income support policies in Australia. With the release of unit record tape data by the Australian Bureau of Statistics (ABS), the ability to develop sophisticated computer models of personal incomes and expenditures has increased markedly. The models are being applied to analyse the impact and cost of actual government policies, of policy proposals and to track developments over time in family incomes and living standards.

With the development of such models occurring simultaneously in a number of research institutes and government agencies, and at a rapid pace, a need to exchange information and techniques and expose the models to peer review was apparent. With this in mind, the Workshop summarised in this Report was organised with three specific aims:

(1) To bring together Australian researchers involved in the development of tax-benefit models and microsimulation methods, with a view to sharing common developments, methodologies and difficulties and to highlight the similarities and differences in work currently in progress;

(2) In light of the first meeting of the OECD Experts Panel on Microsimulation Models in July 1990, to allow the author of the Australian paper for the meeting (Phil Gallagher) to obtain comments on the draft of his paper for the OECD meeting; and

(3) To develop a forum for on-going discussion of issues relating to microsimulation model *development*, model *application*, model *validation* and, perhaps of greatest significance, issues relating to *data availability, scope and cost.*

The participants invited to the Workshop represent a group of researchers from each of the relevant Australian research institutes and government agencies, as well as representatives from ABS.

In reviewing the current state of development of tax-benefit and microsimulation models in Australia, it is difficult not to compare the situation today with that occurring some two decades ago with the development of macroeconometric models. At that time, I was at Southampton University which was developing a very large macroeconometric model, inspired in large part by the theoretical work of Professor Ivor Pearce. He took the view that once the model had sorted out the basic 'what is' (objective) economic issues, we could turn our minds to the more important 'what should be' (subjective) questions. In the event, the model(s) never got beyond the 'what is' questions and became increasingly bogged down with the 'what is' questions, until Robert Lucas developed his devastating rational expectations critique of the use of econometric models for policy evaluation purposes in the early seventies. Let us hope that we do not tread a similar path in developing and applying tax-benefit models and microsimulation techniques—but let that experience at least be a warning to us not to set our own expectations too high as to what such models can deliver.

I would, finally, like to express my gratitude to the Commonwealth Department of Social Security for financial assistance without which this Workshop would not have been possible. It is extremely encouraging to see the very close collaboration and cooperation that has developed between those working in government and those in the research community in this area of social policy research. This Workshop has hopefully helped to advance that even further, and the Report itself should serve to make this work available to a wider audience.

Peter Saunders
Director

ACKNOWLEDGEMENTS

The editor would like to express his gratitude to Jenny Doyle, Diana Encel and Nicky Woodburn for their assistance in the organisation of this workshop and in the compilation and production of this volume.

CONTENTS

OVERVIEW

Microsimulation is the synthetic generation of data about social and economic 'micro' units. The focus of most microsimulation exercises is the creation of data describing the economic situation of households, though the same methods can be extended to focus on non-economic questions, or on alternative units such as firms. These simulations are undertaken for two main reasons:

- To combine different data sources to provide more adequate descriptive accounts of the economic situation of households, and how these have changed over time. Microsimulation is necessary because available data sets are either incomplete, unavailable or not timely enough to address the questions of researchers and policy makers;
- To evaluate the impact of hypothetical changes on either the policy, social, or economic environment of households.

Most such simulations have in common a concern with the effects of policy changes on the living standards of persons and households, and consequently the development of *tax-benefit models* is a major component of most microsimulation exercises.

In many countries microsimulation models are an increasingly important part of the policy making process. Whilst policy development has always involved the estimation of costs (or revenue), together with some evaluation of the likely winners and losers, the increasing complexity of policy makes the use of more sophisticated microsimulation models desirable. This is particularly so in the policy areas of taxes and transfers, where tax-benefit models (of varying degrees of sophistication) can be used to describe the interactions of many different policies. In Australia however, the use of tax-benefit models, and microsimulation models generally, is still relatively undeveloped. With the new availability of suitable data in the 1980s, however, we are beginning to see a rapid and varied development of modelling capacity. Bringing the users of such methods together was one of the main reasons for the Social Policy Research Centre holding the workshop from which the papers in this report are derived.

The first three papers in this volume are survey papers—with the scope of the surveys progressively narrowing in each paper in turn. Otto Hellwig's paper begins by surveying microsimulation methods in other countries. Whilst the early developments of systematic microsimulation models can be traced back to the 1950s, it was not until the late 1970s that the first major conferences on this topic were held. After something of a lull during the 1980s, recent years have seen a resurgence of interest in these methods. Most of the initial household microsimulation models were developed in either the USA or West Germany, but the field has now substantially widened to include many other countries.

In his overview, Hellwig distinguishes between several different types of microsimulation models. These models can be distinguished by the extent of factors modelled (e.g. calculating changes in net incomes vs more systematic incorporation of behavioural responses), as well as by the methods used to 'age' data sets to reflect changes over time. 'Static ageing' involves the re-weighting of the microdata base in order to reflect the changes in some (small) set of calibration variables over time. 'Dynamic ageing' is much more ambitious, and simulates the longitudinal data base that might be obtained by observing individuals over time. Whilst much more complicated, this latter method is significantly more flexible in the relationships that can be incorporated.

The main applications of these models have been for analysing the revenue and distributional implications of tax and transfer policy options, with most applications based on static microsimulation methods (i.e. using static ageing). The main use of dynamic models has been to simulate accumulation processes (e.g. savings behaviour) and to analyse policy impacts over the life cycle.

In comparison to the US and Europe, microsimulation is still in its infancy in Australia. None-the-less it is clear that a birth has occurred. Phil Gallagher's paper provides an overview of the current state of the art of Australian tax-benefit and microsimulation models. Whilst Australian policy evaluation has long used simple models of revenue projections and of policy impacts on hypothetical families, comprehensive simulations of the impacts of taxes and benefits only began in the mid 1980s. However, in the last few years there has clearly been something of a 'growth spurt', with Gallagher now able to identify 22 Australian tax-benefit models (of varying degrees of sophistication) in current or recent use. The 'parent' of this growth of activity has undoubtedly been the release by the Australian Bureau of Statistics of unit record tapes from its income and expenditure surveys. The continuing requirement for such data is a point made forcefully by Gallagher, and was one of the main points of discussion during the workshop (see the summary of discussion).

To date, the majority of the tax-benefit and microsimulation models in Australia have been developed by the academic or research communities rather than by government departments. One of the main goals of Gallagher's paper is to identify the most appropriate way for the Australian Department of Social Security to develop a more sophisticated modelling system for the evaluation of tax-benefit policy options. To this end, his paper reviews in detail the methods and coverage of existing Australian models. This information is summarised in a set of tables in the appendix to his paper.

The organisation most prominent in microsimulation in Australia has been the National Institute of Economic and Industry Research (NIEIR). An overview of the research of this institute is given in the paper by Anthony King, Will Foster and Ian Manning. Up until recently, most of their simulation has been based on static ageing models, with an impressively long list of applications since 1985. These include:

- Evaluations of tax-benefit reform options associated with the 1985 Draft White Paper, the election platforms of the major parties in 1987, the 1987 Family package and alternative age pension proposals;
- Estimation of national and Victorian poverty incidences;
- Estimating the changes in disposable incomes between 1982 and 1987;
- Projections of housing affordability; and
- Estimating the incidence of state concessions.

As well as briefly describing these applications, the paper also presents an introduction to the current research being undertaken at the Institute on dynamic microsimulation. An illustrative example is presented showing the impact of an expansion of superannuation on age pension coverage. The authors conclude with a summary of the lessons they have learned from the experience of microsimulation at the NIEIR—lessons that should be of relevance to all practitioners (and commissioners) of such research.

Whilst the first three papers are essentially survey articles, the last two papers of the volume are much more specific in the issues they address. The paper by Bruce Bradbury addresses one of the key practical difficulties in the static ageing of household data bases—how to adjust for the changing labour market status of the population. In particular, he addresses the question of the impact of the significant labour market changes in the Australian economy since 1981 on the level and distribution of family incomes.

The method used by Bradbury seeks to achieve three main goals: to separately identify changes in the distribution of the population between the states of not in the labour force, unemployed, part-time employed and full-time employed; to identify the trends in the combined labour market status of husbands and wives; and to separately identify labour market trends for families with and without dependents. Whilst this entails some limitations on the extent of disaggregation by other characteristics such as age, it is argued that adjustment according to these criteria encompasses most of the important labour market status changes over the decade.

Since 1983-84 it is estimated that the increase in wives' participation and the overall decrease in unemployment have had roughly equal impacts in increasing the total disposable incomes of families (though with the effect of unemployment slightly greater). Labour market status changes had the greatest impact on the incomes of sole parents, for whom they are estimated to have led to income falls of around 4.5 per cent between 1981-82 and 1983-84, followed by an increase of 6.1 per cent in the years thereafter. On the other hand, labour market changes for single persons over the decade have tended to decrease their average incomes. Couples (of working age) without dependents have generally fared better than couples with dependents over the period—mainly because of the larger impact of participation increases for wives without dependents (who are more likely to work full, rather than part time).

Within each family type, the situation of the very bottom of the income distribution was generally little changed by labour market changes, as most of these people were non-participants over the whole period. The greatest changes in average incomes were experienced by those deciles with slightly higher incomes. The exception to this however was couples with dependents. The average incomes of the bottom decile of this group are estimated to have fallen by 11 per cent mainly as a result of unemployment increases between 1981-82 and 1983-84. Because of the consistently low levels of wives' labour force participation when husbands were not employed, only a small proportion of this income loss has been made up in the years since. The paper concludes with a comparison of these results with those obtained from earlier research by the Social Policy Research Centre. In most (but not all) cases, the new method seems an improvement over the old.

The key results in Bradbury's paper, like most other microsimulation results, are estimates of effects on *incomes*. For the analysis of winners and losers, it is not always clear that this is the most appropriate measure. Bradbury, for example, points to the difficulties in interpreting the increased income flowing from increased labour market participation. Whilst incomes may rise, something else is sacrificed (home production or leisure time). Some more general measure of welfare would seem desirable.

An additional limitation of other simulations that simulate tax or transfer changes is that often behavioural changes (for example any change in labour supply with a change in tax rates) are ignored. In the final paper of this report, Glenn Jones presents an introduction to the *Reform of the Australian Tax and Social Security System* (RATSSS) project. The key goal of this project is to address these two issues by incorporating the simulations into a model based upon the economic theory of household labour supply, consumption and welfare.

The key point of Jones' paper is that labour supply, consumption and savings should be considered as choice variables, and that different choices are likely to be made under different policy regimes. Since cash incomes (via labour supply) are thus choice variables, it is not correct to simply use cash income as the welfare measure to evaluate different policies. Rather, estimation of welfare impacts requires the systematic incorporation of the 'preference maps' of households. Jones argues that 'a model that implicitly fixes labour supply or restricts the range of elasticity responses is not likely to estimate revenue changes very well, nor is it likely to answer important questions concerning changes in behaviour such as labour force participation or savings behaviour'.

For researchers to begin to realise the potential of this research program, however, will require a large amount of data about the way households respond to policy changes. This question of data availability was also the main topic of discussion during the workshop—for the whole exercise of tax-benefit modelling and microsimulation depends upon the availability of household and person level data. This report concludes with a summary of the discussion that took place during the workshop.

Of particular interest to most researchers was the question of access to the unit records from future ABS surveys. Access to this (or equivalent) data was generally viewed to be an important requirement for continued microsimulation research in Australia. (Though as Peter Saunders points out in his discussion of the papers by Hellwig and Gallagher, the absence of such data may also increase the reliance upon microsimulation methods to create synthetic data sets). The weight which is attached to this call for more data must obviously be evaluated in the light of the actual and potential usefulness of tax-benefit models and microsimulation methods. The papers in this report go a good distance towards establishing the value of this research methodology.

Bruce Bradbury.

THE OVERSEAS EXPERIENCE WITH MICROSIMULATION MODELS

Otto Hellwig
National Institute of Economic and Industry Research, Melbourne

1. INTRODUCTION

This conference on microsimulation, the first in Australia, is in line with the increasing interest in microsimulation world wide. The first major conferences on microsimulation were held in the late seventies and early eighties: 1980 in Sweden (Bergmann, Eliasson and Orcutt, 1980); 1982 in West Germany (Bendisch and Hoschka, 1982); 1983 in West Germany, (Orcutt, Merz and Quinke, 1986). These conferences were indicative of the large interest in microsimulation in the late seventies and early eighties.

There was then a period of stagnation or even decline in interest in microsimulation in the mid eighties which has, however, been followed by a strong boom in the last two years. Indicative of this are the many recent conferences and panels on microsimulation: 1987 in Hungary (Wolf, 1990); 1988 in the USA (*Conference on Software Systems and Income Transfer Policy–Recent Technical Developments*, Washington D.C.; and Department of the Treasury, 1988); then there is a panel led by Professor Hanushek which aims to define the current state of application of microsimulation and to identify the potential demand for microsimulation in the USA; and recently the OECD panel on microsimulation was established with its first conference to take place in July 1990 in Paris.

While the organisers of the conferences in the early eighties were generally within the scientific community, the more recent conferences were initiated and sponsored by governmental agencies, which up to now are also the major users of microsimulation. The development of microsimulation was mainly application driven. It is a logical step that the major users now want to summarize the past experience and find out what has to be done in order to consolidate and increase the application of microsimulation models. This is an appropriate time to do so in Australia.

2. INTRODUCTION TO MICROSIMULATION

Basically, microsimulation starts with a sample of micro-units (e.g. persons, households or firms[1]) and applies a model to produce a new, simulated sample (Figure 1). The results observed in the simulated sample are assumed to be representative of the real population. For example, one can apply an alternative tax scheme to the *1986 Income Distribution Survey* to analyse what the effects of the alternative tax scheme probably would have been if implemented in 1986. The unique capability of microsimulation is that one can generate virtually all types of statistical information by analysing the simulated sample, e.g. distributions, cross distributions, tables and information on any interesting sub-population can be calculated. In addition, one can perform winner/loser analysis, i.e. finding out who benefits and who suffers from the expected general demographic and economic development, or alternative economic or social policies under review.

For example, in the case of analysing an alternative tax scheme shown in Figure 2, one might wish to calculate the total tax revenue, the change of the Gini coefficient and check whether rich income units or large families would profit from the new tax.

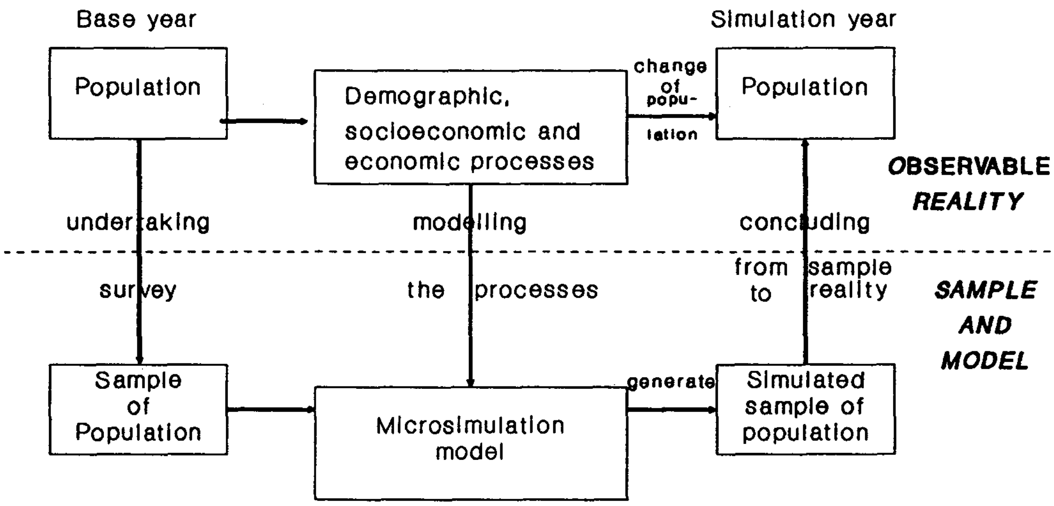
While the capacities for analysis of the simulated samples are identical for the many existing microsimulation models[2], several types of modelling are used. These reflect the needs of the applications, e.g. do only direct effects or also indirect (second order) effects need to be taken into account, is a short term or a medium term projection required, and is only cross-section information or is life cycle information needed. Applying these questions to the example of analysing the impact of

---

1 This paper restricts itself to microsimulation of the household sector. The major notable micro model of the firm sector has been developed in Sweden, see Eliasson (1985) and Appendix.

2 With the exception of life-cycle analysis, as discussed further below.

Figure 1: The Principle of Microsimulation



alternative tax schemes on disposable incomes, Figure 2 illustrates three alternative microsimulation methods.

Modelling approach (1), see Figure 2, is termed a *calculator* as only institutional regulations (e.g. tax scheme, social benefit laws) are simulated and no behavioral response is accounted for.[3]

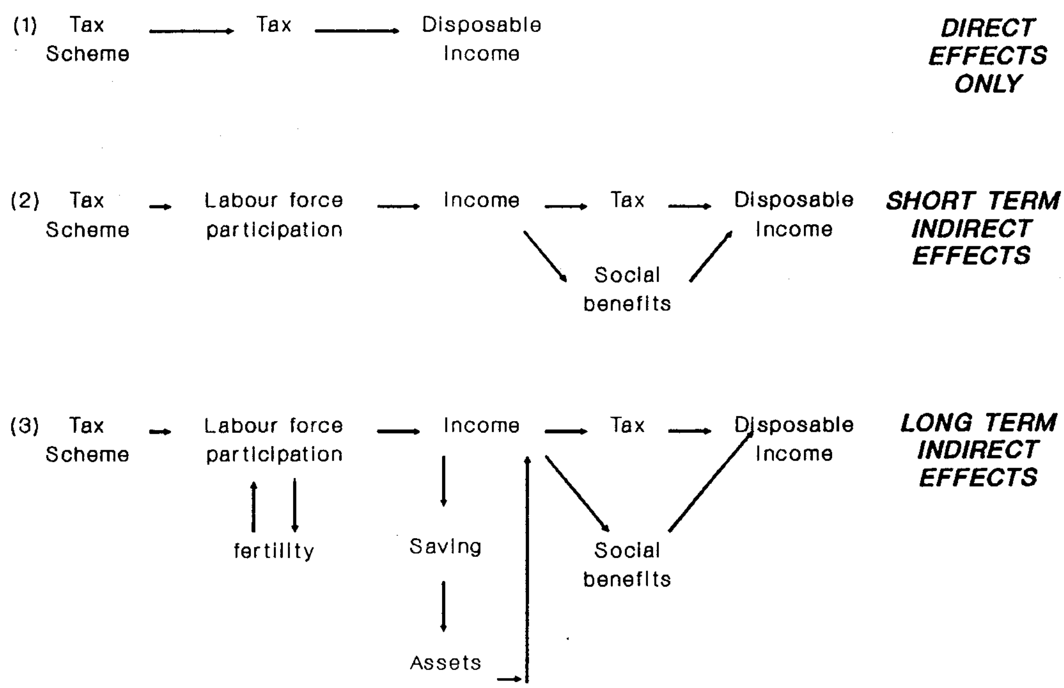
The decision to include labour force participation in *modelling approach (2)* requires behavioural modelling and thus statistical estimation. The literature on this subject is extensive and all the glory of econometrics and all the misery of missing information and specification problems which are reported there will apply to the microsimulation model. The major problem is the lack of appropriate longitudinal microdata in some countries. Hence transition probabilities often have to be calculated using disaggregated macrodata (e.g. number of marriages and population to calculate marriage probabilities) or cross-section microdata has to be reinterpreted, see Galler (1988) and Hellwig (1988b). Two methods are used to apply the behavioral model on the microdata: dynamic ageing and static ageing.

Dynamic ageing simulates the attributes (e.g. work force participation) of each person at time t+1 using the attributes at time t. This is achieved by applying the behavioural equation to each person of the microdata base using a Monte Carlo simulation. For example, imagine that for a specific person the probability of work force participation is calculated to be 0.7 (e.g. by applying a logit regression to the attributes of that person). Now, one draws a random number which is uniformly distributed between 0 and 1. If this random number is smaller than 0.7, work force participation will be simulated for that person, otherwise the person will be assumed not to be in the work force. In case an entry to work force is simulated, the wage has to be generated, e.g. by using regression equations.

Static ageing, on the other hand, re-weights the microdata base in such a way that in our example the projected work force participation rate is matched. In general, the projected rates are not based on the microdata base but are externally supplied. In many cases, macroeconomic models based on disaggregated time series methods are used. Generally, one tries to differentiate these rates at least with respect to age group and sex.

3 A few models have variable participation rates for social benefit schemes and hence are not considered to be calculator models.

Figure 2: Examples of Modelling Direct and Indirect Effects



It should be noted that static ageing is variable-oriented, while dynamic ageing is process-oriented. For example, static ageing of a microdata base using a projection of the age and sex structure implicitly accounts for the processes death, birth and immigration each of which are, however, separately modelled in dynamic ageing. While reweighting is feasible for discrete variables, (e.g. labour force participation) as well as for continuous variables (e.g. income and tax), mostly it is used for discrete variables. When static ageing is used, continuous variables generally are updated in a similar way as in dynamic ageing: for income, one mostly uses global inflation factors, whilst for tax and social benefits, institutional regulations are applied.

Dynamic ageing and static ageing can to some degree be mixed in microsimulation models. For example, the demographic processes (death, birth, marriage, divorce etc) can be modelled using static ageing and labour force participation can be aged dynamically using regression equations. However, in order to take full advantage of dynamic ageing, all the attributes of the persons in the microdata base which are explanatory variables in the behavioural model should also be aged dynamically. Otherwise, the work force participation rate calculated will be constant for each person over the simulation years because with static ageing the attributes of all persons remain constant over time, only the weights are changed. Other combinations such as dynamic ageing for demographic processes and static ageing for retirement will produce inconsistent results. The reason being that no new age cohorts are generated by static ageing and thus the retirement probabilities of dynamic ageing are repeatedly applied for the same persons.

For these reasons, static and dynamic ageing methods are rarely combined in microsimulation models. As a consequence they can be termed static microsimulation models or dynamic microsimulation models. The major differences between static and dynamic ageing are summarized in Figure 3. Static microsimulation models are rather partial models and are mainly used for short term analysis of alternative tax and social benefit regulations. Dynamic microsimulation models often aim to model all relevant processes and are applicable for medium and long term analysis in an even wider range of areas than static models.

Figure 3: Comparison of Dynamic and Static Ageing

Dynamic ageing	Static ageing
Ageing through application of persons behavioural assumptions to each individual person.	Ageing through reweighting all using group specific tables of weights.
Ageing is process specific, that is the behavioural assumptions are specified for each process (e.g. marriage, entering labour force).	Ageing is variable specific, that is the variables which are used to define the weight tables (i.e. weight variables) are specified.
The variables are changed according to the behavioural assumptions, the weights generally remain constant.	All variables remain constant, only the weights change over time.
All variables, which are not explicitly changed by some process, stay constant over the simulation years.	Statistical variables which are not explicitly aged through inclusion in the weight tables are changed by ageing in uncontrollable way through the correlation of these variables with the weight variables.
Requires extensive modelling work.	Requires differentiated external projections.
No such restrictions.	Restricted modelling possibilities, e.g. limited number of processes.
Requires considerable amount of modelling and of computer resources.	Requires little programming and little computer resources.
Produces a sequence of cross-sections as well as life cycles.	Produces a sequence of cross-sections.
Can produce inconsistent or unrealistic households when poor modelling is used.	When population structure changes much, overweighting of specific types of micro-units can occur.
Produces Monte Carlo error.	When weight tables from different sources are used (i.e. only marginal distributions are known) a consistent weight table has to be generated.

Returning to Figure 2, *Modelling approach (3)* includes simultaneity of behavioral processes (e.g. of labour force participation and fertility) and cumulative processes (accumulation of assets). The accumulation of assets cannot conveniently be modelled using static ageing. Using dynamic modelling one just adds the estimated net savings of the simulation year t to the assets at t, giving the assets at year t+1.

If the application requires life cycle information, modellings (2) or (3) are appropriate and dynamic ageing has to be used throughout. In static ageing the individual persons are not aged. Rather each person of the microdata base is reweighted in each simulation year thus representing a different birth year cohort each year. Hence although static ageing produces a sequence of microdata bases it is not possible to connect the persons of the various microdata bases.

If one is mainly interested in life cycle information, one may use a specific variant of dynamic ageing, which is referred to as a *longitudinal model*. Longitudinal models age each person over their life cycle (or a part of the life cycle), then the next person is aged etc. That is life cycles are generated. In contrast, the standard dynamic ageing, which can be referred to as a cross-section model, ages all persons for one year to generate the microdata base for the next year. This process will be repeated for each simulation year thus producing a sequence of cross-sections. Longitudinal models are computationally more efficient than cross-section models because each micro-unit has to be read and written only once. However, they suffer limitations when modelling interactions between persons, such as marriage. Generally, longitudinal models generate a spouse if marriage is simulated. That is, no marriage market is simulated and there is no closed modelling.

Another subtype of dynamic ageing contains *cohort models*. These do not use a representative sample of the whole population as microdata base but only the cohort of interest is selected and simulated. Thus cohort models have similar problems to longitudinal models when modelling marriage; often there are no appropriate spouses in the microdata base when marriage is simulated for a person. As longitudinal models are computationally more efficient than cross-section models, cohort models are generally implemented as longitudinal models.

Figure 4: **Types of Microsimulation Models**

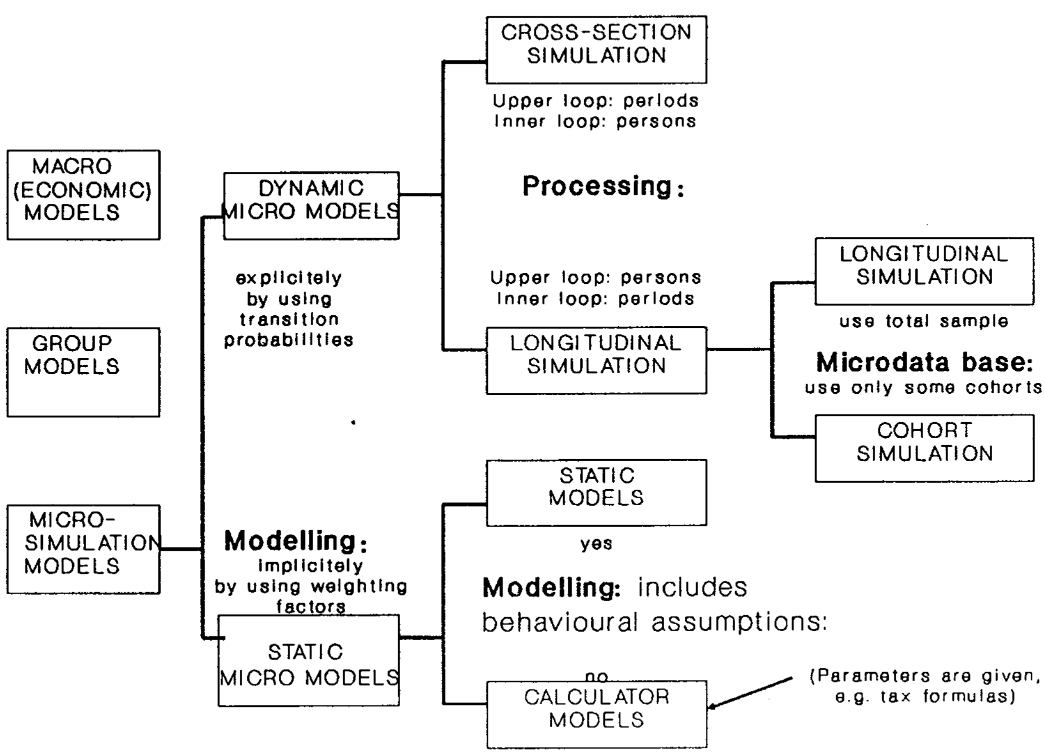


Figure 5: Strengths and Problems of Microsimulation Models

STRENGTHS	PROBLEMS
Use of microdata	*Comprehensive data sets required*
• microdata contains more information then aggregated data	• mostly no survey exists with all information required
• the micro-level is the real process level	• large computational burden
• enables very differentiated modelling (e.g. selection processes, response heterogeneity, interaction between agents).	• much modelling work required
• enables modelling of the various types of micro-units (e.g. persons, income units, families, households) and their relationships and interactions (restricted for static models)	• complex programs are required (mainly for dynamic models)
• microeconomic foundations of the modelling is possible	• microeconomic theories are often not sufficiently developed yet to make full use of existing data and/or require information which is not available
Strong modularization of modelling possible	*Problems in modelling simultaneity of the various processes*
• Different modelling approaches can be used in the various modules	
Can use various information without information loss : microdata, grouped /disaggregated data, common knowledge, institutional regulations	*Consistency of the various data sources has to be checked, adjustments and recalculations often become necessary*
Does not suffer estimation problems such as	*Unexplained variance is generally high thus*
• very high multicollinearity	• the distribution of the estimated residual has to be modelled
• restriction of more differentiated modelling (e.g. more explanatory variables) due to few degrees of freedom	
Monte Carlo simulation as method for model solving avoids numerical problems (dynamic models only)	*Monte Carlo variance has to be reduced and analysed (dynamic models only)*

A general longitudinal model can almost without modification simulate just a few cohorts instead of the whole microdata base. The requirements to convert a cross-section model to a longitudinal or a cohort model generally are not too great, in contrast to the other way around. These various types of microsimulation models are depicted in Figure 4. This figure also indicates that the terms generally used are somewhat ambiguous, e.g. calculator models often are referred to as static micro-models.

The main strengths and problems of microsimulation are summarized in Figure 5. The attributes named in Figure 5 refer to static as well as to dynamic models (although sometimes to a quite different extent) unless stated otherwise.

Finally, it should be noted that group models which are based on grouped data exist, and take an intermediate position between macro-models (which use aggregate data) and micro-models. Typical examples of group models are the population models which differentiate population by age and sex (giving 200 groups for example) and which age this population by applying death and birth probabilities to the various cells. Most national bureaus of statistics in the developed countries use such models. Some group models are confusingly referred to as micro-models, presumably in order to differentiate them from macro-models. However, group models have limited capabilities when compared with micro-models, e.g. the group models can hardly be used for distributional analysis and the number of variables to be included are limited. Comparison between group models and microsimulation models can be found in Greenbeger, Crenson and Crissey (1976), Krupp (1978) and Okner (1978).

3. THE TECHNICAL REALISATION OF MICROSIMULATION MODELS

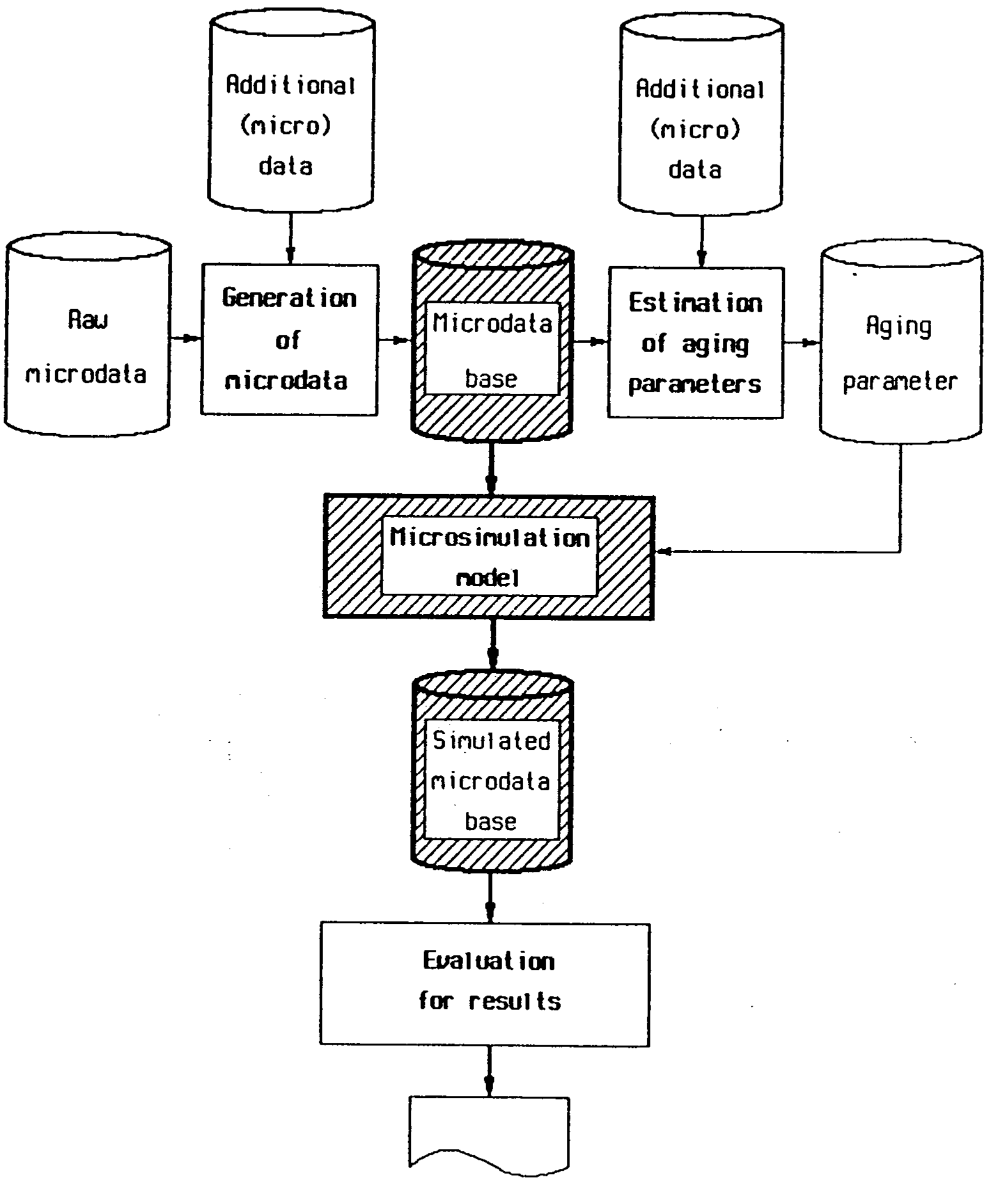
Figure 6 shows the technical tasks which are required in order to construct and to run a microsimulation model.

Generation of microdata: the available samples (e.g. unit record tapes of censuses or household expenditure surveys) often do not contain all the required variables or the variables are not coded in an appropriate manner. As a result, re-coding of variables, generation of new variables or even merging of microdata bases need to be carried out. Basically, two types of merging algorithms are used: imputation using regression functions and using distance functions to identify two very similar micro-units for transferring the missing variables.

The first methods for merging data were developed in the USA in the late 1960s and early 1970s and merging was intensively and controversially discussed, see Okner (1972) and the following comments in that journal. Although the methodological problems of merging are not solved (and probably not solvable) there now exists a general consensus that merging is often unavoidable and acceptable if proper care is taken when interpreting the results. While the early merge algorithms were of a heuristic nature, Paass(1986) developed theoretically based algorithms. However, these are not yet widely used. A survey of merge algorithms is given by Paass (1982). For merging, no general software packages exist.

Estimation of ageing parameters: the ageing parameters need to be estimated either by using the microdata base itself or by using additional data. Almost all microsimulation models use only a few statistical models for the behavioural assumptions: regression models, one dimensional distributions and group models (as estimated by the AID program of Sonquist, Baker and Morgan, 1971). For more details on the use of statistical models in microsimulation systems see Klevmarken (1980) and Hellwig (1988a). Statistical software packages like BMDP, SAS or SPSS can be used for estimating ageing parameters. However, these packages do not fit the needs of microsimulation too well: they were primarily designed for smaller data sets, most of the packages do not contain the AID program, see Sonquist, Baker and Morgan (1971) and the RAS algorithm, see Bungers (1981) and Ireland and Kullback (1968), many essential tests of model specification, see Kraemer and Sonnberger (1986), are not included and the interface to other systems is often not sufficient. For example, most packages cannot save and further process the parameters estimated by, say the OLS programs, the parameters are merely printed out. Thus it is not possible to generate files with ageing parameters for the microsimulation model directly. In addition, the printout often contains only a limited number of digits, which may lead to rounding errors in subsequent simulations. For these reasons it may become advisable to program some procedures by themselves. The possibilities to program algorithms with the commands of the statistical packages are mostly very limited, mainly because the packages

Figure 6: **Programs and Data Flow Within a Microsimulation System.**
The central parts of the microdata base and microsimulation model are shaded.

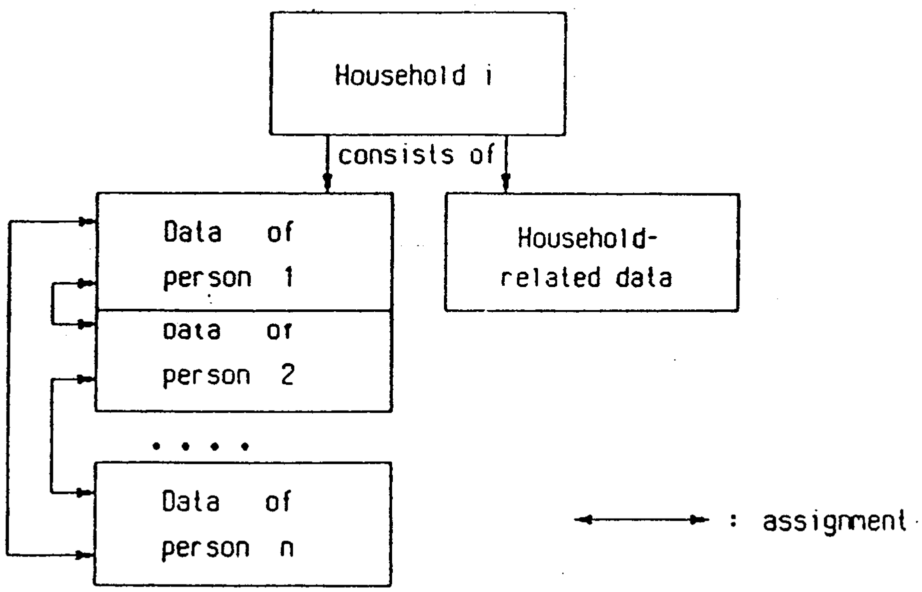


perform a loop which cannot be controlled by the user over all cases of the used data set. Thus FORTRAN may be used to program additional procedures to complement the statistical package used.

The microsimulation model itself: in the case of a static model, programming is straight forward. Even statistical packages such as SPSS or SAS can be used for this task. However, with dynamic models far more demanding tasks need to be accomplished, including the following:

1) Handling of various types of micro-units and their relations and the dynamics of these relationships. For example, the relationships between persons, income units, families and households may need to be handled. This will require definitions and updating of quite a few assignments, see Figure 7.

Figure 7: **Data Structure and Assignments when only Persons and Households are Modelled.**



2) Market simulation, mainly the marriage market. Here, men and women for whom marriage is simulated have to be matched according to some matching criteria, e.g. a given distribution of age differences. Generally, a sorting approach is used for the realisation of the marriage market: each person for which potential marriage is simulated is written onto a marriage file for men or a separate marriage file for women.

   When all relevant persons are in the marriage files, they are sorted. For example, the file of the men who will marry is sorted with respect to the age of the men, while the file of the marrying women is sorted according to the ideal age of the husband. Then matching of the spouses takes place. One problem is that generally the distributions of the match variables (e.g. age) in the two marriage files differ. In this case there are difficulties in matching all persons. Additional problems arise if matching criteria are included for women as well as for men. A more powerful but computationally more demanding approach of market realisation is described in Hellwig (to be published).

3) The simultaneity of most processes: more than one process can take place within one simulation period, e.g. giving birth and divorce for a person. As these processes are not independent, the sequence in which they are modelled is of importance. Simulating birth prior to divorce leads to too many births and too few divorces (as the probability of divorce declines with the number of children); simulating divorce prior to birth produces the opposite effect (as the probability of a birth is smaller for non-married women than for married women). Most microsimulation models use a fixed sequence when simulating the various processes, which leads to some distortion. One way of solving this problem is to choose a random sequence of processes for all persons, and to modify the estimation of the ageing parameters accordingly, see Hellwig (to be published).

4) Evaluation of results: for evaluation of stock data (e.g. number of persons with respect to age and sex) one can use the same programs as for the estimation of the ageing parameters. For dynamic microsimulation models one generally wishes to calculate flow data, e.g. the number of births simulated. This needs programming in the microsimulation model itself. Therefore the definition of flows to be evaluated always has to be defined prior to the simulation, contrasting the situation for stock variables.

Dynamic microsimulation models impose high requirements on this programming, mainly because of the demanding tasks described above and the large computational burden. In order to fulfill the general requirements on software (e.g. maintainability, flexibility, portability, efficiency, user-friendliness), software engineering methods should be applied when specifying, designing and coding the software, see Hellwig (1990). Further sources for information on EDP aspects of microsimulation are: Pankoke-Babatz (1980b), Kloesgen (1986) and Mueller (1986). Hellwig (1989) gives an overview of the microsimulation software of some major models.

4. HISTORY OF DEVELOPMENT AND APPLICATIONS OF MICROSIMULATION MODELS

4.1 Overview and Chronology of Microsimulation Models

In Figures 8 and 9 a selection of the major microsimulation models are listed chronologically. Further information is provided in the Appendix. In cases where the date of the reference given differs from the year the model became operational, this year is given after the model's name. After the literature reference we give the developer, followed by the types of applications undertaken with the model. Finally comments on the model and the country are given.

Figures 8 and 9 do not list all models which are described in the literature, e.g. Merz (1988), Nelissen (to appear), Harding (1990). Earlier surveys of microsimulation models were provided by Harris (1977) and Krupp and Wagner (1982). It is estimated that world wide there exist 13 dynamic and 25 static microsimulation models at least. These models cover at least demography, taxes and social benefits. In addition, many more partial models are known. In many countries the ministries of finance use calculator type microsimulation models, c.f. Lietmeyer (1986) and OECD (1988). About 20 demographic models are known, see Orcutt, Caldwell and Wertheimer (1976), Nelissen (to appear) and Appendix. Interestingly, the demographic models have been little used. In most cases just one academic application was reported, then the models appear to have vanished. Apparently the statistical bureaus have not used these models for their regular demographic projections but still use their group models. In addition, there exist some very specific models for study of the labour market and unemployment, see Ballot (1982), and Kapteyn, Woittiez and ten Hacken (1989). Eltetoe and Vita (1987) analysed invisible income (shadow market activities). These models, however, appear to be highly specific and partial microsimulation models which are not really comparable with the more general models described in Figures 8 and 9.

Then there are extremely simplistic microsimulation models which more or less analyse a microdata base by applying some elementary assumption to the microdata. One example would be the analysis of the impacts (e.g. aggregate expenses of the program and change in income distribution) of an increase of child allowances by some amount. Any appropriate household survey could be used for this purpose and no ageing of this survey to some current year would take place. The model can be implemented in a few lines of computer code. Such calculations are performed in a number of studies and often without reference to the fact that a version of the microsimulation approach is used.

Finally there are a couple of models situated between microsimulation models and group models. That is, they use only a small number of typical micro-units, e.g. the model by Bennett and Bergmann (1986).

Figures 8 and 9 show that the microsimulation technology was conceived in the US by Guy Orcutt in 1957. The first model SUSSEX was operational 4 years later. The first real application (however using a calculator model only) took another 4 years, (Pechman, 1965). From there 10 years passed until the first application in another country, West Germany, was realised in 1975, see Herzfeld (1982). At about the same time a large research group working on the development of microsimulation models was founded in West Germany, see Krupp (1973). This project took 8 years to complete the first major application, (Krupp et al., 1981). This is to be compared with the 19 years between Orcutt's seminal article on microsimulation and the first dynamic microsimulation model, see Orcutt, Caldwell and Wertheimer (1976). Then we have another gap of about 10 years between the start of microsimulation in the FRG and other countries, notably UK and Hungary in 1986, see Atkinson and Sutherland (1988) and Elteto and Vita (1986), which developed static microsimulation models. Interestingly, Elteto had tried to develop a dynamic model along the lines of Orcutt's first model SUSSEX already in the late seventies. However, he found the problems and work load at that time to be too large. Since 1986 a considerable number of models, dynamic as well as static ones, have been developed or are under construction in many developed countries such as Australia, Canada,

Figure 8: The History of Microsimulation Models in the USA.

	Dynamic Models	**Static Models and Calculators**
1957	Orcutt (1957), first article on microsimulation	
1960	SUSSEX,Orcutt et.al (1961); Univ. of Wisconsin; demographic modules only, experimental without application.	
		Pechman(1965); Treasury department; tax calculator.
1970		RIM, McClung (1970); President's commission on income maintenance and income transfer plans; calulator
		TRIM, McClung et.al (1971); Urban Institute; tax and social benefits
	DYNASIM, Orcutt et.al. (1976); The Urban Institute; 3 implementations of DYNASIM exist: MASH, MASS, MICROSIM; longterm projections, social security, energy.	MATH, Beebout (1977); Mathematica Policy Research; tax and social benefits.
1980		TRIM2, 1980, Webb et. al. (1986); Urban Institute; reprogramming of TRIM.
		TIITSM, 1980, Cilke et. al. (1987); Office of Tax Analysis; tax calculator.
	DYNASIM2, 1983, Wertheimer et. al. (1986); reprogramming of DYNASIM to a combined cross-section longitudinal model, also some respecifications; applications as DYNASIM.	STATS, Roen (1982); Department of Health & Human Services; tax and social benefits
	PRISM, Kennell et. al. (1984); ICF Inc.; specifically tailored for retirement income analysis.	
	CORSIM, 1987, Caldwell (1990); reprogramming of DYNASIM on PC; no application yet.	

Legend: ——→ *model has been overtaken and modified*

- - - - - - -→ *the same developer(s) involved (personnel transfer)*

Figure 9: The History of Microsimulation Models in Other Countries.

	Dynamic Models	Static Models and Calculators
1975		Wohngeldmodell, 1975; Herzfeld (1982); IABG Corp.; calculator for housing allowances scheme; FRG.
		BAFPLAN, 1977; Bungers and Quinke (1986); Institute for Mathematics and Computing; training assistance act; FRG
1980	Sfb3, Krupp et. al (1981); Frankfurt University; social retirement scheme and several academic applications; very detailed modelling, longitudinal version exists, PC version at work; FRG	BASYS, 1982; Vetterle (1985); BASYS Corp.; social health insurance; uses administrative data; FRG.
1985	DPMS, 1985, Heike et. al (1990); Darmstadt University; new methodologies and software engineering used; methodological studies only; FRG.	APF, Gyarfas et. al (1985); Institute for Mathematics and Computing; family allowances; implemented in model bank system; FRG
		TAXMOD, 1986; Atkinson et. al (1988); London School of Economics; tax analysis; UK.
	HCSO, 1988, Cicsman et. al. (1990) Hungarian Central Statistical Office;tax and social benefits; planned to become a user–friendly general purpose instrument; Hungary.	
		SPSD/M, 1988, Statistics Canada (no date); calculator for tax and transfer income, user–friendly, on PC, publicly available, including microdata base; Canada.
1990	NEDYMAS, 1988, Nelisen (1990) Tilburg University; social security and life time income; Netherlands	
	DEMOGEN, Wolfson (1989a); Statistics Canada; divorce, health, pension; longitudinal model; Canada	

Legend: ——→ *model has been overtaken and modified*
- - - - - - -→ *the same developer(s) involved (personnel transfer)*

Czechoslovakia, Hungary, Netherlands and Sweden. In other countries, such as the Soviet Union, there is considerable interest in microsimulation and some studies in the discipline have already been undertaken, see Volkov and Darsky (1987).

4.2 Development and dissemination of microsimulation

The development of microsimulation in the USA was completely application driven. Orcutt was an academic (Professor of Economics at Harvard University) at the time he developed the concept of microsimulation. However, Orcutt had been involved in work for the government, the World Bank and private research institutes for most of his life, see Orcutt (to appear). The microsimulation models have been developed in private research institutes, notably the Urban Institute and MPR, being heavily funded by the users and also by research grants. Major users were and still are various departments and offices within the social security administration, the Congressional Budget Office and other public institutions. Only very few applications for the private sector have been reported so far. However, it should be be noted that not all applications are reported in the literature.

In the USA there was a rapid spread of microsimulation models in the early 1970s. The basic microsimulation model TRIM, and later on the dynamic microsimulation model DYNASIM, were transferred to several other private research companies. In addition, several major users took microsimulation models in house, notably the Department for Health, Education and Welfare. This rapid spreading of microsimulation technology has been enabled by personnel transfer. That is, members of some microsimulation working group left the group and joined some other research company or governmental department, using their knowledge and experience to set up microsimulation models there. In some cases program code has also been transferred and been used for further developments. These personnel transfers are considered to having been of major importance for the development of microsimulation in the USA, see Fallows (1982).

In other countries there have been only few transfers of microsimulation knowledge, models or software. The notable exception being the transfer of the Darmstadt model to the Hungarian Central Statistical Office, see Hellwig (1984, 1985), Cicsman and Papp (1987), Zafir (1987), Cicsman, Papp and Zafir (1990) and Hellwig (1990). This transfer has been undertaken within the framework of a convention on cooperation between Darmstadt University and the Hungarian Central Statistical Office. Not only the model has been transferred but also the microsimulation software as well as knowledge and experience on microsimulation. As a first step the Darmstadt model has been adapted for Hungarian data and applied. Using this experience the Hungarian working group developed its own Hungarian microsimulation model as well as their own software. However, many modelling and programming approaches have been taken over. Microsimulation working groups in Czechoslovakia and Yugoslavia have expressed their interest in co-operation with the Hungarian Central Statistical Office in order to transfer the microsimulation technology which is currently established in Hungary. It is to be hoped that the chain of transfer of microsimulation technology and knowledge will continue and thus support the further development and dissemination of microsimulation throughout the world. In fact, there have been many parallel developments in several countries within the last few years. In order to make the work re-usable there have been several efforts to develop a more portable microsimulation software, notably in West Germany, Canada and USA, see Heike, Hellwig and Kaufmann (1988a), Hellwig (1990), Statistics Canada (no date) and Caldwell (1990). However, these developments have not been very successful yet, the reason being that it is very hard to develop software which is flexible as well as easy to understand. While the software of the Darmstadt microsimulation model is very flexible it is very sophisticated and hard to understand for a casual programmer, see Hellwig (1990). The CORSIM software (Caldwell, 1990), on the other hand appears to be not sufficiently flexible. Although significant progress has been made with the development of portable software, it appears that transfer of microsimulation still has to be model and knowledge based, rather than being a software transfer.

The development of microsimulation models in Germany predominantly took place at universities and government funded institutions. In particular, the GMD (Association for Mathematics and Computing) developed and operates several microsimulation models for governmental departments. Thus, the funding situation for microsimulation is much better in Germany than in the USA where the models are developed by private research institutions. The latter have the problem that clients generally pay only for applications rather than for the development and the maintenance of the model. Dissemination of knowledge on microsimulation models and the fact that some major users have taken microsimulation models in house has improved the understanding of users and of funding organisations for the necessity of financing development and especially maintenance of microsimulation models. However, it is felt that the funding situation in the USA has never been sufficient. This may be the major reason why the development of microsimulation in the last 10 years predominantly took place in Germany rather than in the USA. A reasonable set of techniques for performing microsimulation applications has been available for at least ten years in the USA. Perhaps it was for this reason that it was hard to obtain funding for methodological improvements as most funds for the development of microsimulation models are being raised by performing applications. In contrast, in Germany progress has been reported in microsimulation methodology, see Merz (1985, 1986), Heike, Hellwig and Kaufmann (1990), and Hellwig (to be published), in merging, see Paass (1986), in data availability (especially the Socio Economic Panel), see Hanefeld (1984), in micromodelling, see Galler (1980), the various working papers of the Sfb3 at Frankfurt University, e.g. Ott (1986) and Heike, Hellwig and Kaufmann (1988b), in software see Kloesgen and Schwarz (1982), Heike, Hellwig and Kaufmann (1988a) and Hellwig (1990).

Another problem in the further development and dissemination of microsimulation techniques is the relatively poor communication between the various working groups. In fact there are no journals specialising in microsimulation, no association for microsimulation and none of the economic societies have sub chapters or working groups on microsimulation. Thus, the more or less randomly organised conferences on microsimulation or the general economic conferences which have a section for microsimulation are the major means of communication for the various workers in this area. Recognising these problems, Morrison (1988) recommended the establishment of a regular forum for microsimulation, of University chairs for microsimulation and a journal specialising in microsimulation and closely related areas. In the long term Morrison (1988) aims for microsimulation to become a recognised and somewhat formalised discipline.

4.3 Microsimulation from a User Perspective

Figures 8 and 9 suggest that most applications have been performed for the analysis of tax schemes and social benefit regulations. It is estimated that forty five per cent of the applications were made on taxes, forty five per cent on social benefit schemes and about 10 per cent on other areas, including housing, health, education, demography, expenditure analysis and wealth.

Tax models appear to be the most heavily used. For example, Cilke and Wyscarver (1987) report that thousands of proposed changes to the income tax code for the US have been analysed during the course of the tax reform initiative. While the academic interest in microsimulation often concentrates on analysis of the distribution of effects, for the users in the tax department, total revenue of the alternative tax scheme and the analysis of the impact on special predefined income unit types are often of higher interest. That is, the possibility of microsimulation models to perform case studies and calculate total revenue is a major argument for tax departments to apply microsimulation models. It is believed that many tax departments do not use the full capacity of microsimulation models for distribution analysis and winner/loser analysis. Similarly, the analysis of the re-distributional effects of alternative social benefit schemes is generally restricted to predefined groups of income units, families or households rather than to statistical winner/loser analysis. The AID algorithm, see Sonquist, Baker and Morgan (1971) and Breiman et al. (1984), is a useful method to identify the types of families or households which gain or which suffer most from the alternative policy. However, it appears that this method is not widely used yet in microsimulation.

It appears that most users are more interested in the exact modelling of very specific elements of the alternative policy under review, rather than in a more comprehensive modelling of other processes in order to estimate second and third order effects. In fact, the precise modelling of regulations is a straightforward task while including behavioural assumptions is often very difficult, see Harding (1990).

Apparently the users have been satisfied with the results of microsimulation models. A major reason for this may be that in most microsimulation models there are only few controversial and critical assumptions compared to, for example macroeconomic models. It appears that there have been only few requests for validation of the models and for analysis of the Monte Carlo variation and of the sample variation by users, as these tasks have been reported for only a few models and in some cases not before some applications had already been made. Examples for such validation work are Kormendi and Meguire (1988) and Nelissen (1988) for the calculation of the standard deviation of the results of his microsimulation runs.

A major concern of users generally is the fact that the microdata bases which are available are generally several years old. However this concern is not specific to microsimulation models. Rather it is possible to use microsimulation models to generate current microdata base. If less comprehensive and less sophisticated models are used, however, the generated microdata base will to some large extent have still the same structure as the old microdata base.

Many users have complained that the application of microsimulation required too much time. In order that results are useable within political discussion they must be available within days or even within hours rather than in weeks. This time factor is possibly one of the reasons why several users took microsimulation models in house in the seventies in the USA. However, some users, confronted with the operation of a microsimulation model found it too large, too hard to understand and too difficult to modify. Early efforts to make microsimulation models user friendly failed, see Sadowsky (1977)and Pankoke-Babatz (1980a). More recent work at the GMD, see Kloesgen (1986), was partly successful. That is, some of the users at the governmental departments use the microsimulation models by themselves for at least some of the simulations, while other users still prefer to contract most or all simulations out to the GMD. The Hungarian Statistical Office has very ambitious plans for making their microsimulation software extremely user friendly, see Cicsman, Papp and Zafir (1990).

5. CONCLUSION

Microsimulation is already widely used for the analysis of alternative tax schemes and social benefit regulations. Within the last few years the development of microsimulation models and its application have rapidly increased. It can be anticipated that within a few years microsimulation will become the standard tool for policy analysis in many areas. However, the potential of microsimulation has been exploited only to a small degree. As the next step in the application of microsimulation, which has already started internationally, the microsimulation community aims:

- at performing more complete analysis, that is, accounting for second and third order effects;
- to do medium term projections and life cycle analysis rather than mainly short term analysis; and
- to significantly increase application to other areas such as, labour market, employment, expenditure, housing, immigration, migration and health.
- for a closer collaboration of microsimulation specialists with demographers and economists specialising in wages, labour market, consumption and savings behaviour, immigration etc. Both sides would greatly profit as on one hand the modelling of microsimulation models could be improved whilst on the other hand behavioural estimation requires dynamic validation in addition to the common static validation (i.e. mainly tests), c.f. Nakamura and Nakamura (1985).

In order to achieve these aims a considerable amount of work is required, which includes the development of dynamic microsimulation models, the availability of longitudinal microdata, such as panel data and last but not least the linkage of microsimulation models to macroeconomic models of the national economy. The developers of microsimulation models have to respond to increased requirements of software quality (user-friendliness, portability, flexibility), to validation and to analysis of the stochastic properties of the results generated by their model. Better communication within the microsimulation community and work division certainly could increase the speed of progress significantly.

REFERENCES

Atkinson, A.B. and Sutherland, H. (Eds) (1988), *Tax Benefit Models*, ST/ICERD Occasional Paper No. 10, London School of Economics, UK

Ballot, G. (1982), *Micro-macroeconomic Simulation of the Labour Market and System Dynamics: Model ARTEMIS*, Paper presented at the VIIth International Conference on System Dynamics (held in Brussels), University of Paris II, Paris.

Beebout, H. (1977), *Microsimulation as a Policy Tool: The MATH Model*, Policy Analysis Series No. 14, Mathematica Policy Research Inc., Washington, D.C.

Beebout, H. (1986), 'Evaluating Reagan administration social program changes: two applications of MATH', in Orcutt et al. (1986).

Bendisch, J. and Hoschka, P. (Eds) (1982)(1983), *Moeglichkeiten und Grenzen sozio-oekonomischer Planungsmodelle*, Two Volumes, GMD-Studien No. 68 and No. 73. St. Augustin: Gesellschaft fuer Mathematik und Datenverarbeitung, FRG.

Bennett, R.L. and Bergmann, B.R. (1986), *A Microsimulated Transactions Model of the United States Economy*, John Hopkins University Press, Baltimore/London.

Bergmann, B., Eliasson, G., and Orcutt, G.H (Eds), *Microsimulation–Models, Methods and Applications*, IUI Conference Reports 1980, Industrial Institute for Economic and Social Research, Stockholm.

Betson, D., Greenberg, D., and Kasten, R. (1980) 'A microsimulation model for analysing alternative welfare reform proposals: an application to the program for better jobs and income', in Haveman and Hollenbeck (1980).

Breiman, L. Friedman, J. Olshen, and R. Stone,C. (1984), *Classification and Regression Trees*, Wadsworth.

Breu, F. (1982), Die Mikrosimulation als ein Verfahren der Bevoelkerungsvorausschaetzung, dargestellt am Beispiel Muenchen, Muenchner Statistik, Monatsbericht 5/1981, pp. 113-125.

Bungers, D. (1981), 'Microanalytic simulation models as tools for legislative planning' *Simulation*, 36(4), 111-118.

Bungers, D. and Quinke, H. (1986) 'A microsimulation model for the German Federal Training Assistance Act - principles, problems and experiences', in Orcutt et al. (1986).

Caldwell, S.B. (1990), 'How can microsimulation help develop better theories?', in Wolf (1990).

Cicsman, J. and Papp, E. (1987), *The Software Prepared for the Household Statistics Microsimulation in the HSCO*, Paper presented at the International Workshop of Demographic Microsimulation of the IIASA, Budapest.

Cicsman, J., Papp, E. and Zafir, M. (1990), The Hungarian microsimulation on household statistics data, in Kreuz and Schmidt (1990).

Cilke, J.M. and Wyscarver, R.A. (1987), 'The individual income tax simulation model', in *Compendium of Tax Research 1987*, Office of Tax Analysis, Department of the Treasury, Washington D.C.

Department of the Treasury (1988), *Proceedings of the Workshop on Microsimulation Modelling, May 10, 1988 in Washington D.C.*, Vols 1 and 2, USA.

Egidi, V. and Tomassetti, A. (1988), *A Method for Projecting Families*, Paper presented at the IIASA Conference on 'Future Change in Population Age Structure', October 18 to 21, Sopron, Hungary.

Eliasson, G. (1985), *The Firm and Financial Markets in the Swedish Micro to Macro Model-Theory, Model and Verification*, IUI, Stockholm.

Eltetoe, O. and Vita, L. (1987) *A Microsimulation Approach to Assess the Distribution of Invisible Incomes*, Hungarian Statistical Office, Budapest.

Fallows, S.E. (1982), *Implementation by Personal Transfer: The TRIM/MATH-Model*, Internal Report IPES.82.0207. St. Augustin: Gesellschaft fuer Mathematik und Datenverarbeitung, FRG.

Galler, H.P. (1980), *Konzeption einer mikroanalytischen Verteilungstheorie*, Frankfurt University.

Galler, H.P. (1988), 'Microsimulation of household formation and dissolution', in Nico Keilman, Anton Kuijsten, Ad Vossen (Eds), *Modelling Household Formation and Dissolution*, Clarendon Press, Oxford.

Greenberger, M., Crenson, M. and Crissey, B. (1976), *Models in the Policy Process: Public Decision Making in the Computer Era*, Russel Sage Foundation, New York.

Gyarfas, G. and Quinke, M. (1985), *APF - Ein DV-gestuetztes Analyse-und Planungsinstrument fuer den Familienlastenausgleich, Documentation*, St. Augustin, FRG.

Hanefeld, U. (1984), 'Das Sozio-oekonomische Panel', *DIW Vierteljahresberichte*, 4/84, pp. 391-406.

Harding, A. (1990), *Dynamic Microsimulation Models: Problems and Prospects*, paper presented at the British Sociological Association Annual conference, University of Surrey, UK.

Harris, R. (1977), *Microanalytic Simulation Models for Analysis of Public Welfare Policies*, The Urban Institute, Washington D.C.

Heike, H. D., Hellwig, O., Kaufmann, A. (1988a), 'Der Darmstaedter Mikrosimulator-Modellansatz und Realisierung', *Angewandte Informatik* 1/88, 9-17.

Heike, H. D., Hellwig, O., Kaufmann, A. (1988b) 'Das Darmstaedter Mikrosimulationsmodell, Ueberblick und erste Ergebnisse', *Allgemeines Statistisches Archiv*, 72, 109-129.

Heike, H.D., Hellwig, O. and Kaufmann, A. (1990), 'Experiences with the Darmstadt Microsimulation Model (DPMS)', in Wolf (1990).

Hellwig, O. (1984), *Einfuehrung in die Mikrosimulation und Anwendungsmoeglichkeiten fuer den ungarischen Haushaltssektor*, paper presented in the Hungarian Statistical Office, Budapest, December 4, 1984.

Hellwig, O. (1985), *Entwicklung verbesserter Mikro-Regressions-Modelle zur Konsumschaetzung*, paper presented in the Hungarian Statistical Office, Budapest, October 17, 1985.

Hellwig, O. (1988a), *Probleme und Loesungsansaetze bei der Datenbeschaffung und Parameterschaetzung fuer Mikrosimulationsmodelle der privaten Haushalte*, Ph.D. Dissertation, Darmstadt University, West Germany.

Hellwig, O. (1988b), *Microanalytical Modelling and Estimation of Interhousehold Mobility using Cross Section Microdata*, Paper presented at the Conference on Future Changes in Population Age Structure, IIASA, Sopron 17 to 20 October 1988, Hungary.

Hellwig, O. (1989), *Microsimulation Software-State of the Art and Outlook*, paper presented at Softstat 1989 in Mannheim, West Germany, to appear in the forthcoming procedures.

Hellwig, O. (1990), *Programming a Microanalytic Simulation Model using Software Engineering*, in Kreuz and Schmidt (1990).

Hellwig, O. (to be published), *Implementing Simultaneity and Markets in Microanalytic Simulation Models*.

Herzfeld, B. (1982), *Entwicklung von Wohngeldsystemen*, in Bendisch et al. (1982).

Howell, N. and Lehotay, V.A. (1978), 'AMBUSH: A computer program for stochastic microsimulation of small human populations', *American Anthropologist*, 80, pp. 905-922.

Ireland, C. T. and Kullback, S. (1968), 'Contingency Tables with Given Marginals', *Biometrika*, 55, 179-188.

Kapteyn, A., Woittiez, I. and ten Hacken, D. (1989), *Household Labour Supply in the Netherlands in the Eighties and the Nineties*, OSA working paper no. W61, Gravenhage, The Netherlands.

Kennell, D.L. and Sheils, J.F. (1984), *Revised Documentation of the ICF Pension and Retirement Income Simulation Model (PRISM)*, ICF Incorporated, Washington, D.C.

Klevmarken, A. (1980), *On Estimation and other Problems of Statistical Interference in the Microsimulation Approach*, in Bergmann, Eliasson and Orcutt (1980).

Kloesgen, W. (1986), 'Software implementation of microanalytic simulation models - state of the art and outlook' in Orcutt, Merz and Quinke (1986).

Kloesgen, W. and Schwarz, W. (1982), *Features and System Architecture of the Model Bank System MBS*. In A. Javor (Ed.), *Discrete Simulation and Related Fields*, Amsterdam, North Holland.

Kormendi, R.C. and Meguire, P. (1988), *Dynamic Validation of the TRIM Welfare Simulation Model*, working paper, The Urban Institute, Washington D.C.

Kraemer, W. and Sonnberger, M. (1986), 'The linear regression model under test', *Physica*, Heidelberg, Wien.

Kreuz, H. and Schmidt, B. (Eds) (1990), *Entwicklungstendenzen in der Computersimulation*, Springer (forthcoming).

Krupp, H.J. (1973), 'Sozialpolitisches Entscheidungs und Indikatorensystem fuer die Bundesrepublik Deutschland (SPES)', *Allgemeines Statistisches Archiv*, 57, 380-387.

Krupp, H.J. (1978), 'The pros and cons of simulations on the basis of individuals or groups in micro-models', in Pfaff (1978) pp.445-452.

Krupp, H.J., Galler, H.P., Grohmann, H., Hauser, R. and Wagner, G. (Eds) (1981), *Alternativen zur Rentenreform 84*, Campus, Frankfurt/M. and New York.

Krupp, H.J. and Wagner, G. (1982), 'Grundlagen und Anwendung mikroanalytischer Modelle', in Bendisch, J. and Hoschka, P. (Eds) *Moeglichkeiten und Grenzen sozio-oekonomischer Modelle*, GMD-Studien No. 68, St. Augustin, FRG.

Lietmeyer, V. (1986), 'Microanalytic tax simulation models in Europe: development and experience in the German Federal Ministry of Finance', in Orcutt, Merz and Quinke (1986).

McClung, N. (1970), 'Estimates of income transfer program direct effects', in *The President's Commission on Income Maintenance Programs, technical studies*, US Government Printing Office, Washington D.C.

McClung, N., Moeller, J. and Sigual, E. (1971) *Transfers Income Program Evaluation*, Urban Institute Paper 950-3, Washington D.C.

McKay, C. (1978), *Micro Analytic Simulation System, Technical Documentation of the MICROSIM Model*, Washington D.C.

Merz, J, (1985), 'Ein modifiziertes Newton-Verfahren zur Loesung des Hochrechnungsproblems nach dem Prinzip des minimalen Informationsverlustes', *Computing*, 35, 51-61.

Merz, J. (1986), 'Structural adjustment in static and dynamic microsimulation models', in Orcutt, Merz and Quinke (1986).

Merz, J. (1988), *Microsimulation - A Survey of Principles, Developments and Applications with Focus on the Static Case and the Static Sfb3 - Microsimulation Model as an example*, Working Paper No. 268, J.W. Goethe-Universitaet Frankfurt, Frankfurt a/M, FRG.

Morrison, R. (1988), 'Future directions', in *Department of the Treasury* (1988), Vol. II, pp. 15-20.

Mueller, G.P. (1986), 'Data structure requirements of microanalytic simulation models', in Orcutt, Merz and Quinke (1986).

Nakamura, A. and Nakamura, M. (1985), *The Second Paycheck: A Socioeconomic Analysis of Earnings*, Academic Press, New York

Nelissen, J.H.M. (1988), *Microsimulation of Household and Education Dynamics*, working paper, Tilburg University, The Netherlands.

Nelissen, J.H.M. (1990), 'A microsimulation model for the Netherlands', in Wolf (1990).

Nelissen, J.H.M. (to appear), *The Redistributive Impact of Social Security Settlements on Lifetime Labour Income.*

OECD (1988), *A Comparative Study of Personal Income Tax Models*, Paris.

Okner, B.A. (1972), 'Constructing a new data base from existing micro data Sets - the 1966 Merge File', *Annals of Economic and Social Measurements*, Vol. 1, No. 3, pp. 325-42. See also the following comments.

Okner (1978), 'Comments on Krupp' (1978), in Pfaff (1978), pp. 453-456.

Orcutt, G. H. (1957), 'A new type of socio economic systems', *The Review of Economics and Statistics*, 58, 773-797.

Orcutt, G.H. (to appear), *From Engineering to Microsimulation.*

Orcutt, G.H., Caldwell, S. and Wertheimer, R. (1976), *Policy Exploration Through Microanalytic Simulation*, The Urban Institute, Washington D.C.

Orcutt, G.H. and Glazer, A. (1980), 'Microanalytic modelling and simulation', in Bergmann, Eliasson and Orcutt (1980).

Orcutt, G.H., Greenberger, M., Korbel, J. and Rivlin, A.M. (1961), *Microanalysis of Socioeconomic Systems: A Simulation Study*, Harper and Row, New York.

Orcutt, G.H., Merz, J. and Quinke, H. (Eds) (1986), *Microanalytic Simulation Models to Support Social and Financial Policy*, North-Holland, Amsterdam.

Ott, N. (1986), *Die Fortschreibung demographischer Prozesse mit dem Mikrosimulationsmodell des Sfb 3, Version 86.0*, Sfb 3 working paper No. 213, Frankfurt University, FRG.

Paass, G. (1982), *Comparison and Evaluation of Statistical Matching Techniques*, GMD internal report IPES.82.0202, St. Augustin, FRG.

Paass, G. (1986), 'Statistical match: evaluation of existing procedures and improvements by using additional information', in Orcutt, Merz and Quinke (1986).

Pankoke-Babatz, U. (1980a), *Einsatz mikroanalytischer Simulationsmodelle in den USA*, GMD working paper, IPES 80.212, Bonn.

Pankoke-Babatz, U. (1980b), *Ueberlegungen zur Entwicklung eines Softwaresystems zur Mikrosimulation*, GMD working paper, IPES 80.213, St. Augustin, FRG.

Pechman, J.A. (1965), *A New Tax Model for Revenue Estimating*, Study in Government Finance, Brookings Institution, Washington, DC

Pfaff, M. (Ed.) (1978), *Problembereiche der Verteilungs und Sozialpolitik*, Berlin.

Roen, M.P (1982), *Documentation of Simulated Tax & Transfer System Microsimulation Model*, 3 volumes, US Department of Health and Human Services, Washington D.C.

Sadowsky, G. (1977), *MASH–A Computer System for Microanalytic Simulation for Policy Exploration*, The Urban Institute, Washington D.C.

Sfb3 (1989), *Handbuch zum Mikrosimulationsmodell, technical documentation*, Frankfurt University, FRG.

Sonquist, J.A., Baker, E.L. and Morgan J.N. (1971), *Searching for Structure (alias AID-III)*, Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor.

Statistics Canada (no date), *SPSD/M - Product Overview*, Electronic Data Dissemination Division, Statistics Canada, Ottawa.

Sulvetta, M. (1976), *An Analyst's Guide to TRIM: The Transfer Income Model*, The Urban Institute, Washington D.C.

Vano, B. (1988), *Das Mikrooekonomische Modell der Bevoelkerungs- und Haushaltsentwicklung*, unpublished manuscript, VUSEI-AR, Bratislava, Czechoslovakia.

Volkov, A. and Darsky, L. (1987), *Problems of Simulation Models Used in Demographic Analysis*, paper presented at the International Workshop for Demographic Microsimulation of the IIASA, Budapest.

Webb, R. et al. (1986), *TRIM2 Reference Manual: The Framework for Microsimulation*, The Urban Institute, Working Paper 3069-01, Washington D.C.

Wertheimer, R., Barnes, R. and Michel, R. (1980) *Evaluation of the 1978 and 1979 Research Panels' Capability of Satisfying the Data Requirements of the Major Microsimulation Models*, Working Paper 1388-02, The Urban Institute, Washington D.C.

Wertheimer, R.II., Zedlewski, S., Anderson, J. and Moore, K. (1986), 'DYNASIM in comparison with other microsimulation models', in Orcutt et al. (1986).

Wilenski, R.G. (1970), 'An income transfer computational model', in *The President's Commission on Income Maintenance Programs, Technical Studies*, U.S. Government Printing Office, Washington D.C.

Wolf, D.A. (Ed.) (1990), *Recent Development in Microsimulation : An International Perspective*, Urban Institute Press, Washington D.C. (forthcoming).

Wolfson, M.C. (1988a), 'Divorce, homemaker pensions and lifecycle analysis', *Population Research and Policy Review*, 8, 25-54.

Wolfson, M.C. (1988b), *The CEPHID Project: Canada's Elderly - Projecting Health, Income, and Demography*, Working paper No.1, Social and Economic Studies Division, Statistics Canada, Ottawa.

Zafir, M. (1987), *Aims and Structure of the Hungarian Microsimulation System on Household Statistics Data*, paper presented at the International Workshop for Demographic Microsimulation of the IIASA, Budapest.

Appendix: The History of Microsimulation Models

Name of model, years of development, Developer	Aim of model, financier, user	Type of model	Aims of software	Type of software, language	CPU needed, no. of cases, computer	Remarks
SUSSEX, 1957-1961, Orcutt et al 1961, University of Wisconsin, USA	Proving that microanalytic simulation is feasible, University funds, no application	monthly, dynamic cross-section	1. effic.	special program, ASSEMBLER	1 hour 7788 persons, IBM 704	First realization of a dynamic microsimulation model. However, modelling was too rough for real application and extremely large computing facilities were required
Tax model, 1963-1965, Pechman 1965, Treasury Department, USA	Analyzing alternative tax schemes. Financier and user: Treasury Department	calculator no aging?	?	Special program, FORTRAN (?)	? UNIVAC 1108	The first microanalytic simulation model which was applied. Since this time the Treasury Department uses microsimulation models, see their actual model below in this table.
RIM, 1968-1969, Wilenski 1970, McClung 1970, President's Commission on Income Maintenance Programs, USA	Analysis of alternative income transfer plans. Financed and used by the Commission	calculator	1.minimal cost of development	special program	?	McClung had experience with microsimulation through his work on the tax model of the Treasury (see above). RIM was extensively used by the Commission during its life. Later RIM was taken in-house by HEW and the Urban Institute.
DYNASIM, 1969-1976, Orcutt et al 1976, The Urban Institute, USA	Policy exploration through microanalytic simulation. Financed by several Foundations and federal government departments,used by the Urban Institute, HEW and the Hendrickson corporation (a profit advisory company), many applications, e.g. private pensions and energy demand.	dynamic cross-section	MASH: 1.user-friendly 2.flexib. MASS: 1.effic. MICROSIM: 1.effic. 2.portability	MASH: micro-simulation shell, FORTRAN, ASSEMBLER, COBOL MASS: special program PL/1 MICROSIM: special program PL/1 FORTRAN ASSEMBLER	MASH: 15 minutes 20 000 households PDP 10 MASS: IBM 360/370 5 times faster then MASH MICROSIM: faster then MASS IBM 360/370	DYNASIM is the first comprehensive dynamic microsimulation model. The first implementation, MASH, Sadowsky 1977 was a very comfortable, interactive system but too slow for professional application. For this reason first MASS, cf. Orcutt et al 1980 and then MICROSIM, cf. McKay 1978 had been developed as simplified and efficient systems. MICROSIM had been develloped for professional use. Later a combined cross-sectional and longitudinal version (DYNASIM 2) has been developed at the Urban Institute, cf. Wertheimer et al. (1986) and applied for some studies.
TRIM, 1971-1973, McClung et al 1971, Sulvetta 1976, The Urban Institute, USA	Analysis of social welfare policies and other socio-economic topics. Financed by Ford Foundation, OEO and HEW, used by the Urban Institute and HEW	calcula-, tor, static aging	1.flexibility 2.efficiency TRIM2: 1.easy to understand & flexibil. 2.user-friendly	special program TRIM2: FORTRAN ASSEMBLER, COBOL	TRIM2: 1 to 10 minutes, 180000 persons, IBM 3090	TRIM is a redesign of RIM (too costly to run, too hard to modify, programming errors induced by constant reprogramming). Many applications, later updated and called STATS cf. Wertheimer et al 1980. Actual version: TRIM2, cf. Webb et al 1986.
Frankfurt Microsimulation Model, 1973-1981, Sfb 3 1989, Galler 1988, Frankfurt University, FRG	Analysis of income distribution and social policy, scientific studies. Financed by German Science Funds Foundation (DFG)	dynamic cross-section, also a longitudinal and a static model exists	1.flexibility & portabil. 2.efficiency 3.minimal cost of developm. & user-friendly	special program, FORTRAN 77	40 minutes, 60 000 persons, COMPAQ DESKPRO 386/20	Comprehensive model with about 200 variables. Only one major application for policy advise (pension system, see Krupp et al. 1981). Recently transfered from a DEC 1091 to a PC. Currently re-estimated using panel data, Ott 1986.

Appendix: (continued)

Name of model, years of development, Developer	Aim of model, financier, user	Type of model	Aims of software	Type of software, language	CPU needed, no. of cases, computer	Remarks
MATH, 1974-1977 Beebout 1977, Mathematica Policy Research (MPR), USA	Analysis of social welfare systems and other socio-economic topics. Used by MPR, Department of Labour and other institutions.	calculator, static aging	1.flexibility 2.efficiency	special program ?	?	An off-shot of TRIM, Beebout has worked with the Urban Institute before joining MPR. Programmed by an external software house, obligatory documentation standards exist. Many applications e.g. Beebout 1986, still in use.
Wohngeldmodell 1974-1975, Herzfeld 1982. Plant Operating Corp. (IABG), FRG	Analysis of housing allowance schemes, financed by Ministry for Construction (BMBAU), used by IABG	Calculator, no aging, adjustments	1.minimal cost of development 2.flexibility	special program FORTRAN IV	Few hours elapsed time for 18000 cases, CYBER 175	First application of microsimulation for a German ministry. The amendments of the Housing Allowances Acts 1977, 1980, and 1986 are based on extensive simulations, which were performed for the Ministry by the IABG.
SIMIKROS, 1975-1980, Mentz and other contracstors, cf. Breu 1982, FRG	Forecasting of population for small regions, e.g. bigger towns. Funds by German Ministry for research and technology (BMFT) Used by statistical offices of several towns.	dynamic cross-section, demographic processes only	1.efficiency	special programm ASSEMBLER, FORTRAN	24 min, 236 000 persons, IBM 370/158	Although simulation results were satisfactory the microsimulator had been applied only for a short time because the calculation of regional aging parameters was too laborious and the simpler cohort (group) models provide sufficient information for the statistical offices.
MOSES, 1975-1979, Eliasson 1985, Industrial Institute for Economic and Social Research (IUI), Sweden	Methodic studies of financial and real dimension, of micro market transmission of inflation etc. Policy analysis, development of economic theory. Funded by IBM, and IUI. Used by IUI and other researchers	quarterly, dynamic cross-section, for firms only, a micro-to-macro model	1.flexibility	special program APL	7 minutes, 250 firms, PRIME	The only micro model of the firm sector. Both micro and macro level are modelled. Pioneering project surveying a part of the required data and develloping models of decision making in firms. Many studies have been performed using MOSES.
AMBUSH 1976, Howell and Lehotay 1978, University of Toronto, Canada	Exploring small human populations e.g. kinship ties, and other kinds of connectivity in small human populations.	dynamic cross-section, demographic processes only, event oriented control	1.efficiency	special program, ASSEMBLER	4 seconds, 500 persons over 200 years, IBM 370	Program is limited to 1000 persons, aging parameters have to be constant over time. Only one application known.
BAFPLAN, 1976-1977, Bungers and Quinke 1986, Corporation for Mathematics and Computing (GMD), FRG	Policy evaluation of German training assistance act, financed and used by Ministry for Education and Science (BMBW)	calculator, but participation rates are estimated, static aging	1.user friendly 2.flexibility	special program, FORTRAN, Model bank system MBS used.	2 minutes, 10000 cases, SIEMENS 7541	Continuously used by BMBW since 1977, more than 100 runs a year model, is continuously updated and maintained by GMD.

Appendix: (continued)

Name of model, years of development, Developer	Aim of model, financier, user	Type of model	Aims of software	Type of software, language	CPU needed, no. of cases, computer	Remarks
KGB, 1977-1977, Betson et al. 1980, Department of Health, Education and Welfare, USA	Analysis of welfare reforms, developed by HEW, used by HEW, DOL and Congressional Budget Office	static	1.minimal cost of development	ad hoc program	25 minutes, 20000 families, IBM 370	was built within one month using subroutines from TRIM and MATH. Several applications. When new laws were discussed in the Congress, 10–12 simulation runs were performed daily.
Treasury Individual Income Tax Simulation Model, 1980 Cilke et al 1987, Office of Tax Analysis (OTA), USA	Estimate the effects of proposed changes to the tax code. Developed and used by the Office of Tax Analysis (OTA).	calculator, but persons use optimal tax options, static aging.	1.efficiency 2.flexibility	special program FORTRAN	30 minutes, 200 000 records, UNIVAC 1100/82	Thousands (!) of proposed changes to the tax code during the course of tax reform initiative have been simulated. Program is designed to compare two or three alternative plans simultaneously.
DPMS, 1980-1986, Heike et al 1990, Darmstadt University, FRG	Methodological studies of micro modelling, and software, funds of the DFG, no application	dynamic cross-section	1.flexibility 2.portability 3.minimal cost of devel.	microsimulation shell, Pseude-code	45 minutes, 127000 persons, UNIVAC 1100/91	The Darmstadt microsimulator has been adopted by the Hungarian Central Statistical Office.
HCSO Microsimulator, 1984-1988, Zafir 1987 Cicsman et al. 1987 Hungarian Statistical Office (HCSO), Hungary	Multipurpose utilization planned: correction and merging of survey data, survey substitution, policy exploration, projections. Financed by national funds, used by HCSO statisticians.	dynamic cross-section	1.flexibility 2.user-friendly: provide support at estimation, and at programming the model	Microsimulation shell, FORTRAN 77, PL/1, relational data base RAPID.	45 minutes, 15780 households, IBM 4361	Within a cooperation the Darmstadt microsimulation working group supported the HCSO's development of a micro model e.g. Hellwig 1984, 1985. The microsimulation software of the HCSO is partly based on the Darmstadt microsimulator. First application in 1988. Development of a model for the business sector is anticipated.
APF, 1984-1985, Gyarfas and Quinke 1985, GMD, FRG	Analysis of family allowances, financier and user: Familiy Ministry (BMJFFG)	calculator, static aging.	1.user-friendly 2.flexibility	special program, FORTRAN, Model bank system MBS used	less 5 minutes 15 000 cases, SIEMENS mainframe	In addition to normal simulation of the complete microdata base, a single (typical) family can be defined and processed
SPSD/M, 1984–1988, Statistics Canada (no date)	Analysis of income tax and transfer income, financier and user: Statistics Canada	calculator static aging	1.user-friendly 2.efficiency 3.flexibility	microsimulation shell, designed for MS DOS PC's, C	8 minutes, 160 000 persons, COMPAQ 386/25	Program including an anonymized microdata base can be bought for 5000 $ which gives the public access to microsimulation for the first time. In addition, Statistics Canada has developed a longitudinal demographic microsimulator, Wolfson 1989a and has just started the development of a dynamic cross-sectional microsimulator, Wolfson 1989b.
NEDYMAS, 1985-1988, Nelissen 1990, Tilburg University, The Netherlands	Analysis of redistributive impact of social security on life time income. Ph.D. grant.	dynamic cross-section	1.flexibility 2.user-friendly 3.portability	special program ALGOL 68	6 minutes, 10000 persons, VAX 8700	A remarkable development of one person within 4 years. Academic applications only.

Appendix: (continued)

Name of model, years of development, Developer	Aim of model, financier, user	Type of model	Aims of software	Type of software, language	CPU needed, no. of cases, computer	Remarks
CORSIM, 1986-1987, Caldwell 1990, Cornell University, USA	Supporting the development of economic theory. Financed by Cornell Univ.	dynamic cross-section	1.user-friendly 2.efficiency 3.flexibility 4.portability	special program C	20 minutes, 20000 persons, 386 desktop	Comfortable menu-driven control. The first microsimulator specifically designed for a PC (AT) supplying many potential users. E.g. Statistics Canada considers adopting the system. Modelling based on DYNASIM2.
DEMOD, 1986-1988, Vano 1988, Research Institute for Social and Economic Information, CSSR	Forecasting and simulation of population and household development,	dynamic cross-section, demogr. processes only	1.minimal cost of development 2.efficiency	special program FORTRAN	15 minutes, 300000 persons, ROBOTRON EC 1055	First application completed, a projection to the year 2010. Extensions to economic processes and use of the Hungarian microsimulation software are planned.
–, Egedi and Tomassetti, 1988, University of Rome, Italy	Analyzing the impact of the current population trends on family size and structure	dynamic cross-section, demographic processes only	1.efficiency	special program, ASSEMBLER	13 minutes, 1 million persons over 50 years, IBM 3090-150 E	Currently a more differentiated modelling is in work. Several program languages have been tried out.

AUSTRALIAN TAX-BENEFIT AND MICROSIMULATION MODELS: AN OVERVIEW

Phil Gallagher
Department of Social Security, Canberra

1. INTRODUCTION

This paper aims to describe the state of the art of tax-benefit modelling in Australia and draw attention to some possibilities for improving the state of the art, at least as seen from a Commonwealth Government perspective. Initial specifications for the new Department of Social Security Policy Effects Model are also given as part of the review.

This review of the state of the art is based on a survey of 22 Australian tax-benefit models (see Appendix A) and a literature search (see Appendix B). The review covers both microsimulation models based on unit record data and major hypothetical tax-benefit models. The latter were included because they offer a guide to the priority areas for modelling policy effects and interactions unencumbered by data limitations.

The appendices to this paper provide detailed reference material on Australian tax-benefit models. Appendix A presents a detailed analysis of the characteristics of four hypothetical tax-benefit models, five static microsimulators based on Australian Bureau of Statistics (ABS) Income Survey unit record tapes, two static microsimulators based on the ABS *1984 Household Expenditure Survey* unit record tape, two models combining a static microsimulator with a hypothetical model (including the new DSS model), two models based on cross-sectional estimation of utility functions and two mixed micro-macro models. The tables in the appendix compare these models in terms of data, coverage, economic updating, reweighting, coverage, output variables, structural alternatives examined and user and programmer interfaces. In addition to analysing these seventeen models, Appendix A also discusses two administrative data simulators, two dynamic microsimulators under development, and one retirement incomes microsimulator being designed. Appendix B lists publications based on the models.

However, before rushing headlong into the details of twenty-two Australian tax-benefit models there are prior issues to be addressed—such as why go to all this effort. That is, reviewing the current Australian modelling effort requires a prior analysis of the Australian social policy context. This will show why tax-benefit modelling is particularly necessary for assessing Australian social and economic policies which effect individuals, families and households. The policy context review also provides some criteria by which we can assess the appropriateness of current Australian modelling priorities.

2. THE AUSTRALIAN SOCIAL POLICY CONTEXT

Australia has three tiers of government. The national government (the 'Commonwealth', 'Federal' or 'Australian' Government) has responsibility for income security, personal income taxation, wholesale sales taxation, labour market training and plays a major role in the finance but not the delivery of most health care, education, housing and personal social services. This latter group of services is delivered by combinations of State Government, local government, private non-profit and private for profit organisations. Non-government provision of nursing home, aged residential, disability and child care services is directly subsidised by the Commonwealth. The Commonwealth also pays a grant to families purchasing a home for the first time.

The six State and two Territory governments are the major deliverers of public education, housing and health services. There are also major non-government alternative systems. The role of private insurance is important for health care but not for other private services. States and Territories supplement their general and special purpose grants from the Commonwealth with income from indirect taxes on payrolls, immovable property, motor vehicles, gambling, and fees and fines. Several of the Australian States share the delivery of public personal social services (e.g. family counselling, child protection, child care, shelter for the homeless) with local government and/or non-government organisations.

Local government is created by Acts of State Parliaments. Until the 1970s, local government largely concerned itself with the provision of physical infrastructure but Federal and State grants have since changed this. The exception was Victoria, where physical infrastructure was transferred to County Councils decades earlier, and there was, and continues to be, much greater involvement in personal social services. Local government has very limited involvement in public housing which is virtually the sole preserve of State and Territory Governments.

This convoluted mix of financing and delivery of social services poses obvious problems of policy coordination and of potential inefficiency. Modelling the interaction of programs at the household level exposes overlaps, gaps and poverty traps. Such modelling cannot be done from administrative data because privacy concerns restrict each agency's collections to data necessary to determine the eligibility and entitlement of its own clients. Matching between agencies is heavily restricted and policed.

These problems of complex program interactions are heightened by the long established Australian preference for income testing income security, public housing, grants to first home buyers and personal social services (especially child care fee relief). This preference is now being extended into the areas of tertiary education (e.g. the Higher Education Contribution Scheme or 'graduate tax') and there have been proposals from outside government to introduce income testing into general health care (e.g. the restriction of free public hospital treatment to the 'disadvantaged').

Income security payments have complex income and asset testing arrangements. The interactions of these means tests with each other and with personal taxation and income tested subsidies is a major determinant of interest in tax-benefit modelling in Australia. The other major determinants are the continuing policy debates on indirect taxation and the effect of alternative personal taxation regimes on labour supply and savings. The policy issues in each of these areas is briefly outlined below.

Interactions with Income Security Income Tests

Four Commonwealth Departments distribute government cash benefits. The Department of Social Security (DSS) pays age, disability and sole parents pensions, unemployment and sickness benefits, family allowances and a family allowance supplement to low income families. A full list is given in the Coverage sections of the tables of Appendix A. The Department of Veterans Affairs (DVA) pays the equivalent of age, disability and widows pensions to veterans and their dependants plus additional allowances for disability and some costs. The Department of Employment, Education and Training (DEET) pays higher secondary and tertiary education allowances as well as training allowances for the unemployed. The Department of Community Services and Health (DCSH) pays a grant directly to first home owners and there have been proposals to make child care fee relief a cash payment.

The most common method for preventing duplication of payment is to 'prescribe' payments. For example, AUSTUDY is a prescribed payment for unemployment and sickness benefits. Some of the more universal payments such as family allowances supplement other payments and some special payments such as the $30pw AUSTUDY supplement can be paid to sole parent and invalid pensioners who are studying full-time. The system of prescription on basic payments is not complete and this can lead to see-sawing income tests or to higher payments. One of the greatest areas overlap is between DSS and DVA payments. The new DSS Policy Effects Model will cover this previously unmodelled interaction.

Australian income security payments are general revenue financed and paid at flat rates providing basic income security. The private insurance and superannuation market necessarily caters for the many Australians who desire higher incomes in the event of retirement, sickness, disability or death. Governments run similar schemes for their own employees. The interactions between the private and public systems have been extensively studied (e.g. Foster, 1988) but seldom modelled. Mr Richard Cumpston of the Institute of Applied Economic and Social Research has started a project which will model public and private contributions to retirement incomes. The dynamic microsimulator being constructed by the National Institute of Economic and Industry Research also will cover superannuation.

Australian pensions and benefits are generally taxable. The taxation system includes pension and beneficiary rebates so that pensioners and beneficiaries with low private incomes do not pay tax. However a person working part-time or with a reasonable superannuation pension will be income tested by both the tax and social security systems.

For example, a sole parent with one child under 5, working part-time can face a pension withdrawal of 50 cents for each dollar of private income and 21 cents in the dollar income tax on the combined pension and wages, resulting in an effective marginal tax rate on private income of 60.5 per cent. If this same sole parent is receiving child care fee relief (withdrawn at 17 cents in the dollar above a total income of $280 or a private income of $153.50) and a public housing rent rebate (20 cents in each dollar) the total effective marginal tax rate on private income could be 79 per cent. In addition the sole parent would face loss of pensioner fringe benefits at $115 per week private income (combined pension and earnings of $209.75 per week) although still qualifying for less valuable low income concessions, and become ineligible for public housing at $460 per week combined income. The Australian Government has introduced a scheme of earnings credits to ameliorate these work disincentives.

The Australian Institute of Family Studies hypothetical model is the only Australian tax-benefit model which incorporates the child care fee relief income test and public rental rebates. None of the models analysed in Appendix A deals with earnings credits. The planned DSS model will cover these and other interactions between income tests.

A much more popular modelling subject has been the possible reconfiguration of tax rebates and cash payments for dependants. The Australian income tax system is based on individuals. The system caters for the different capacity of persons with dependants to pay tax through tax rebates for dependent spouses (with a higher rate for those with children) and for sole parents. The family allowance cash payment is the major horizontal equity measure for those supporting dependent children. Alternative systems of family rebates, refundable tax credits, joint income taxation, lower tax thresholds for family allowance recipients and the cashing out of rebates have been extensively modelled (see the Structural Alternatives sections in Appendix A and the bibliography).

A related topic is the relative work incentives and incomes of husbands and wives. Although income tax is mostly personal, the income tests on government cash and non-cash benefits are based on joint incomes (as is the Medicare levy and the Pensioner Rebate in some cases). In addition the definition of dependency for rebates uses the income of the spouse and children. This means that the marginal tax rates experienced by husbands and wives are not equal. Although base pension payments go to each member of a couple, additional payments for children normally go to the woman pensioner and are subject to complex joint income testing. Married rate Unemployment, Sickness and Special Benefits are paid to one member of the couple, nearly always the husband. Australian research (Edwards 1981) has suggested that many husbands and wives do not share their income.

Many Australian microsimulation models do not currently examine marginal tax rates (see the Output sections in Appendix A). Those that do may model only the income unit MTRs and disposable incomes. One aim of the new DSS model will be to model both the effective marginal tax rates and disposable incomes of income units as well as those faced by husbands and wives. The model will also allow for the deduction of housing costs and child care costs from after tax income. The alternative measures of disposable income will be available on a variety of equivalence scales.

Indirect Taxation

As mentioned earlier, Australia has many and varied indirect taxes levied by Commonwealth, State and local government. The Commonwealth levies a wholesale sales tax, taxes on financial transactions, a petroleum products levy as well as excises on alcohol and tobacco products. The States and Territories impose payroll taxes, estate and gift duties, supplementary petroleum taxes, and taxes on gambling, insurance and motor vehicles as well as fees and fines. Local government imposes rates on immovable property.

Modelling of indirect taxation was to a large extent sparked by a Treasury Draft White Paper in 1985 which canvassed the possible introduction of a broad based consumption tax to replace the wholesale sales tax. This proposal would have subjected food, children's clothing and services to taxation. The proposal included 'once only' compensation for pensioners and beneficiaries through a rise in payments, compensation to employees through income tax cuts and compensation to business through lowering of the company tax rate and the removal of double taxation on dividends.

Although these proposals were never implemented the issue has been an on-going focus for political, business, union, welfare, academic and media attention. As recently as the beginning of May 1990 the Australian Treasurer called a press conference to express the Government's view that there was no need to switch to a broadly based consumption tax at this time. Despite this, the issue is bound to remain on the research agenda of academics and business groups.

The current incidence of indirect taxation on low income groups is an issue of continuing welfare interest. Dr Neil Warren's STATAX model continues to be highly informative on these welfare issues. STATAX and the Centre of Policy Studies model has been used to model extensive changes in indirect taxation along with accompanying tax and social security changes.

The Department of Social Security has an interest in the costs faced by its clients, particularly in housing, child care and health care. The existing system of fringe benefits creates an interest in the usage of concessional services and the value of the concessions to DSS clients. Microsimulation modelling has been identified as an appropriate technique for examining these issues. The National Institute of Economic and Industry Research has done relevant modelling work for two State governments. The new Department of Social Security Policy Effects Model will cover the relevant income tests hypothetically and will eventually be extended to simulate the financial effects of policy changes.

Labour Supply and Savings Responses.

The labour supply and savings responses to the existing system of taxes and benefits are of obvious interest. Several econometric systems of utility and labour supply response have been estimated for married couples with some workforce participation from unit record data by Apps (1988), Savage and Jones. These utility function models differ substantially from other Australian tax-benefit models. The utility functions are used to derive welfare orderings and welfare gains/losses which are then converted to monetary values and labour supply responses.

Since Australia lacks unit record data on savings and indebtedness, the estimation of savings responses has proved difficult. There is major disagreement over the apparent savings ratios found in the Household Expenditure Survey. The Australian Treasury's Draft White Paper (1985, Appendix 22A) claims that the HES data cannot be used to study the incidence of indirect taxation and estimated its own savings ratios. Dr Neil Warren (1987, Chapter 7) disagrees and his STATAX model has estimated the effects of combined indirect taxation, direct taxation and welfare reforms using savings ratios estimated from HES data with outliers removed. Dr Warren has now extended his model to include behavioural responses.

3. THE STATE OF THE ART FOR AUSTRALIAN TAX BENEFIT MODELS

Appendix A contains a detailed dissection of the characteristics of 17 Australian tax-benefit models and briefly mentions 5 others which are not covered by its detailed tables. Both the following discussion and the detailed tables of the Appendix follow the logical organisation of Figure 1 which shows the dataflows for an idealised static microsimulator for Australia. In Figure 1 an arrow represents a dataflow, a circle represents a process and a vertical straight line represents a file.

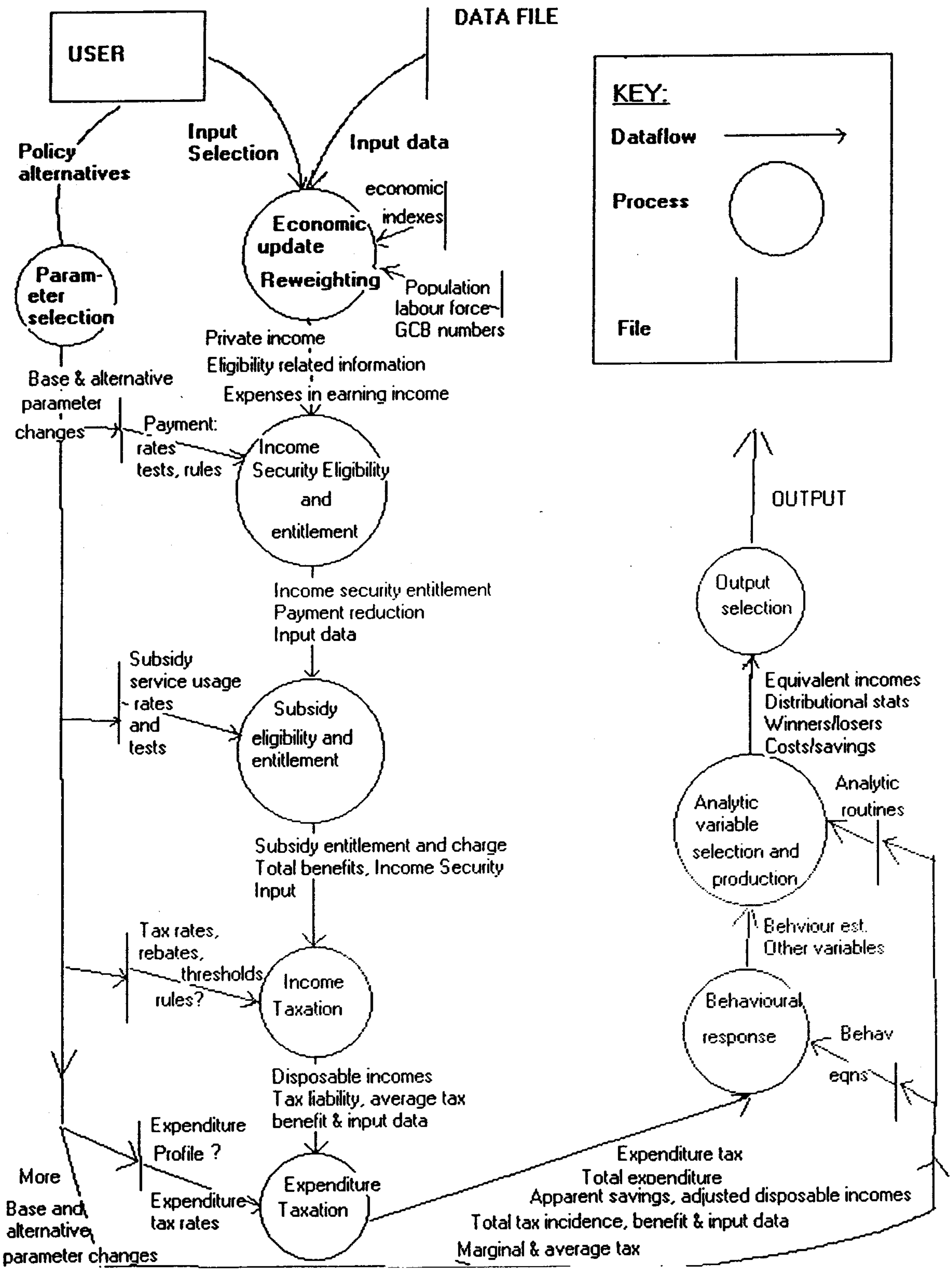
The General Methodology of a Static Tax-Benefit Model

The user of a tax-benefit model ideally specifies policy alternatives by changing parameter files for both the base and alternative systems. The user then selects the cases or variables which are input to the simulation from the data file. For a microsimulator the case records are derived from survey or administrative records. For hypothetical models the records are generated from menu selections.

If needed, the data is updated using economic indices to reflect incomes and prices at the reference time for the simulation. For policy simulations this can involve some projections to the next financial year and beyond. Sample data is reweighted to the reference period using estimates and projections of the age, gender, marital status and family status of the population. Some models also reweight on the basis of numbers of benefit recipients or taxpayers.

Income security entitlement and eligibility is either imputed on the basis of private income by source and relevant age, sex, family status and other eligibility characteristics or derived from payment details on the file.

Figure 1: Generalised Australian Static microsimulator: Top-Level Logical Data Flow Diagram



Subsidy details may be derived from the data or imputed from other characteristics when entitlements for individuals or families are determinable. When they are not determinable, amounts may be randomly assigned with given probabilities within groups or averaged over all members of a group. Subsidy usage rates in a parameter file may be calculated from previous analysis of survey data.

Income taxation is generally imputed from income data rather than being derived from indexing previous payments.

Expenditure analysis can be based on previously generated profiles and mapped onto records or be derived from the input data. Estimation of indirect taxation incidence normally requires some parameters from input-output tables on the percentage of any given indirect tax born by households.

Behavioural responses are usually calculated once full details of changes in average and marginal tax rates and disposable incomes are available. Some modellers may prefer to model the behavioural response to income taxes before expenditures and there is obvious scope for feedback loops to establish equilibrium throughout the model. Such loops are not shown in Figure 1.

Analytic variables based on counts across all records are created before the user specified output is produced.

What is of interest in this paper is how Australian modellers have approached the modelling of these processes and what possibilities exist for improving the models. The logical place to start is with the input data.

Input Data

Appendix A indicates that Australian tax-benefit models are usually based on Australian Bureau of Statistics surveys (13 of 17) and sometimes on no actual data at all (4 of 17). There is no model based on administrative data which covers both taxes and benefits. The Individual Taxpayer Model of the Australian Tax Office simulates only taxation changes on individuals. It only records taxable government benefits and does not match husbands and wives to determine the disposable incomes of families. It is a revenue analysis model rather than a welfare measurement model.

In contrast the Department of Social Security administrative simulations concentrate on income unit ('nuclear family') income and not individual income or tax. The simulations are confined to existing clients with non-client entitlements imputed from ABS data.

The Privacy Act (1988), the Social Security Act (1947) and the Income Tax Assessment Act (1936) all put stringent provisions on the disclosure (and therefore matching) of tax and social security data. To the author's knowledge, the legal status or political acceptability of a possible actual or synthetic match of completely anonymous and confidentialised data has not been investigated.

Section 13 of the Australian Bureau of Statistics Act (1975) allows the relevant Minister to disclose information *other than* 'Information of a personal or domestic nature... that is likely to enable the identification of that person'. Since 1983 the ABS has released 'confidentialised' public use unit record tapes from the 1981 and 1986 Censuses, the 1982 and 1986 Income Surveys and the *1984 Household Expenditure Survey*. These have proved a boon for Australian policy analysis and research. The process of confidentialising these tapes has involved removing name and address and indicators of locality as well as collapsing classifications so that fine details on birthplace, occupation, industry, unusual incomes or other characteristics which could be used to identify an individual are removed.

The concern for confidentiality has also led to the collapsing of information which is of great interest to many policy analysts. For example the distinction between public and private renters was removed from the tapes of the *1986 Income Distribution Survey* and the *1984 Household Expenditure Survey*. This has led the Social Policy Research Centre to impute landlord using a logistic regression based on 21 variables (Bradbury, Doyle, and Whiteford, 1990, p. 73). Even though the resulting estimates were only 48% accurate this was felt to be better than nothing at all.

Similarly, the unavailability of individual incomes in the 1984 HES tape led Dr Neil Warren to manually unpack the household income data so that better tax and social security imputations were possible (Warren, 1987, p. 114).

All users hope that such unfortunate choices for confidentialising data are not made in the unit record tape for the 1988-89 HES which is due for release in September 1990. Even more important, *there are suggestions that this may be the last unit record tape issued by ABS. If this is so it will probably finish* *widespread tax-benefit microsimulation in Australia unless creative and truly satisfactory and affordable alternatives are found.* Systems which allow users to submit programs are being considered but issues such as file structure, turnaround time and cost are yet to be discussed with users. The extensive restructuring, reweighting and economic updating of files required for microsimulation as well as the iterative file runs required for any good analysis or modelling work, and the policy value of such work, deserve recognition.

Where data is available approaches can diverge and the most important example is the choice of either *annual* or *weekly income* which are both available from Income Surveys. Most researchers update annual incomes. The National Institute for Economic and Industry Research (NIEIR) updates annual or weekly incomes depending on the purpose. NIEIR believe that social security entitlements can be more accurately imputed on a weekly basis and that current income is therefore more suitable for use for studies of low income populations. The Social Policy Research Centre and the Australian Institute of Family Studies use annual incomes, while the Policy Coordination Unit used current private incomes to impute current entitlement and then multiplied this by the number of weeks on payment in the imputation of annual incomes. The Australian Government Commission of Inquiry into Poverty (1975) used annual incomes for determining poverty (where available) on the basis that the current weeks income fluctuated too greatly to be a reliable indicator of standard of living. Most Australian research has followed this example and it is very interesting to see the NIEIR making extensive use of current incomes. The new DSS model will be based on the *Household Expenditure Survey* which contains current incomes and tax paid last year. The model will necessarily impute current incomes while annual incomes may only be simulated for those whose current income is consistent with last year's taxable income.

Economic Updating and Related Imputation

Most microsimulators use an appropriate inflator for each source of private income ranging across weekly earnings, national accounts and consumer price indices. The Australian Institute of Family Studies is the only model which indexes all private income sources by average weekly earnings. Australian models do not index source incomes differentially according to size or occupation even though comparative positions may change (e.g. wages and salaries) (Sutherland, 1989).

Government cash benefits show a wide range of update methods corresponding to the imputation methods chosen. For example:

- The Australian Institute of Family Studies (AIFS) uses eligibility as recorded on the data file (file eligibility) and indexes all pensions and benefits by the Consumer Price Index;
- The Social Policy Research Centre (SPRC) has an algorithm for splitting pensions and benefits into components and indexes each component by its own index;
- The National Institute for Economic and Industry Research (NIEIR) Current Incomes Model imputes the current week's entitlement from weekly private income and demographic and labour force characteristics where possible and otherwise uses file eligibility with full imputation of entitlement;
- The Policy Coordination Unit (PCU) used weekly private incomes and file eligibility to calculate weekly entitlement and then used number of weeks on benefit/pension to calculate annual GCB entitlement. GCB recipients were then reweighted to current payment benchmarks; and
- The Centre of Policy Studies (COPS) imputes eligibility where possible and entitlement for all cases on an annual basis.

Sensitivity and accuracy testing on these alternative methodologies appears desirable. The new Department of Social Security microsimulator will necessarily be based on a methodology which best accords with official counts, expenditures and projections. One issue is whether the accuracy of the existing pension and benefit incomes recorded in ABS surveys is good enough to be used for indexing or for complex poverty gap calculations.

The existence of component payments for children and rent assistance complicates the imputation of cash benefits. Many of the imputation procedures (including those of the hypothetical models) do not allow for the payment of additional pension for children to the wife of a married couple and for its complex income testing. This contrasts to the exquisite detail of most models of the Medicare levy in the taxation system. Earnings credits apparently have not been included in any imputation despite being a Government initiative to reduce the incidence of poverty traps.

Many of the microsimulators apply a take-up adjustment to Family Allowance Supplement which has known but difficult to estimate take-up problems. Other payment take-up is taken from the file or from assuming 100 per cent of those with imputed eligibility claim. Since only the PCU model uses payment benchmarks for weighting, these assumptions also deserve testing.

Income taxation is imputed in all models. Many have a formula for imputing deductions and those of the SPRC and AIFS differentiate the level of deductions on the basis of individual characteristics. Most models are restricted to imputing Pay-As-You-Earn liabilities because of data restrictions. The COPS model is notable for the inclusion of a non-reporting factor and provisional taxation while the Warren STATAX model is the only model to cover taxation of minors, the medical expenses rebate and Child Support.

Reweighting

Reweighting methodologies are generally based on population estimates or projections with labour force proportions or estimates disaggregated by gender and marital status. It appears as though only the AIFS, SPRC and the PCU methodologies use sole parent benchmarks. Other models effectively assume that sole parents have shared in the labour force growth of single females.

The PCU methodology subtracts pensioners and beneficiaries by family status and labour force status from the estimated labour force and family status of the population. Non-pensioner and beneficiary estimates sometimes have to be forced to closure because of incompatibilities between payment and ABS statistics.

Research on the goodness of fit of weighting methods has been attempted (listed in the Output Sections of Appendix A). The NIEIR and COPS have checked projections against subsequent income surveys as well as against tax and DSS numbers and expenditures. Dr Neil Warren has checked estimates against taxation statistics. The SPRC has commenced research on weighting methodologies including the use of family status measures (see the paper by Bruce Bradbury in this volume).

Coverage

The models all include the major Department of Social Security pensions and benefits and family payments. The less common DSS payments are not usually included in microsimulators because of lack of data. More surprising is the omission of the more specialised payments for those with disabilities or for orphans or multiple births from hypothetical models.

Most microsimulators rely on the stated level of Department of Veterans Affairs payments because of the absence of information distinguishing payments or permitting the complex entitlement calculations involved. These calculations have not even been modelled hypothetically.

Student Allowances are indexed in most of the microsimulators but omitted from the hypothetical models. Only the ABS Fiscal Incidence Study has imputed class average values for other Department of Employment, Education and Training cash payments and subsidies. There is obvious scope for improved hypothetical modelling of DEET payments and subsidies.

The ABS Fiscal Incidence Study and the COPS model distribute values for community services and health subsidies and low income concessions. The NIEIR has conducted two projects which impute the value of pensioner and low income fringe benefits to income units from usage figures derived from the Household Expenditure Survey.

As previously mentioned, Pay-As-You-Earn income taxation and the major personal taxation rebates are well imputed by all models and COPS impute provisional taxation of non-wage incomes. Some other forms of direct taxation have not been covered because the specialised data required is not available.

The Warren STATAX and the COPS models are the only Australian models to comprehensively impute Commonwealth and State indirect taxation by type using the HES data and input/output tables. The Centre of Policy Studies models include regression equations for broad categories of expenditure which are used to estimate the incidence of Commonwealth indirect taxes using income and other family characteristics.

Analytic Variables

Gross and disposable incomes and equivalent disposable incomes are included in most models. The ABS Fiscal Incidence study covers total benefits and taxes and the COPS model is being extended to do so. The exclusion of subsidies from other models means that they are unsuitable for estimating the social wage or the net redistributive impact of government.

Effective marginal tax rates are included as a standard item in all four hypothetical models but in only two of the ten static microsimulators surveyed (Warren and COPS). This omission is surprising. Point marginal rates are a basic feature of the British TAXMOD and TAXBEN microsimulators which have inspired much Australian work.

All manner of quantile and distributional statistics are used in the Australian microsimulators.

Time Series Analysis

The Department of Social Security has the only hypothetical time series model which is somewhat limited by restricting the pension and benefits analysis to those with no private incomes and the non-recipient analysis to multiples of average weekly earnings.

Time series adjustment is a prominent feature of the academic microsimulators. Those of the PCU and the ABS are fixed to one point in time.

One interesting development is that by the NIEIR of a microsimulator which generates demographic variables for input into a macro-model which is then used to generate twenty year economic projections which allow for such changes as the effect of an ageing population on spending patterns (see Appendix A and Perkins, 1989).

Structural Alternatives and Impact Analysis

The most common structural alternatives examined in the models are changes in dependent related tax rebates, cash payments for families and targeting of the tax threshold using rebates and tax credits. This reflects the continuing political interest in policies for families.

The next most common issue is reform of indirect taxation and the accompanying compensation to taxpayers, pensioners and beneficiaries.

The impact of policy changes in terms of winners and losers, gains and losses as well as savings and costs is common. The Warren STATAX model has been extended to include behavioural response. Apps, Savage and Jones have developed utility function and labour supply estimation systems using Income Survey unit record tapes and applied these to tax reform and family payment issues (Appendix B lists the relevant papers).

From the perspective of Government there is great uncertainty about the validity and appropriateness of methods for modelling behavioural response. Holly Sutherland (1989) cautions a hypothetical government against using behavioural response equations for a limited section of the population and for a specific time in a general tax-benefit model. Proponents of behavioural modelling need to counter her arguments. The complexity and apparent instability of the utility function approach also causes reservations.

Usage

The alternatives modelled reflect the major role of tax-benefit modelling in the policy debate. The academic models are used to develop policy proposals for consideration by political parties, interest groups and Government. The academic models are also used to evaluate proposals from these sources and evaluate the effects of Government policies and economic events over time.

The academic models cannot be used for the ex-ante evaluation of proposals in the budget process and the Government simulation capacity is currently limited to narrow bands of programs which do not comprehend the net effect of broad tax-benefit changes on families and individuals.

The new Department of Social Security tax-benefit model will be able to address interactions between a much broader scope of government programs and model the net effects of simultaneous changes to government cash payments, taxes and income tested subsidies. The model will be user friendly and probably written either in C, as is the COPS model, in MODULA2 like the UK Institute of Fiscal

Studies TAXBEN2, or in SAS/AF. SAS is the language used by all of the Australian mainframe based microsimulators.

4. CONCLUSIONS

Australian tax-benefit modelling is strong in the areas of PAYE income taxation, the major income tax rebates, and the major Department of Social Security payments. Indirect taxation is covered by two sophisticated academic models and some differences over appropriate use of data, especially savings ratios, may still require resolution. The areas of Veterans Affairs payments and of non-cash benefits are poorly covered by policy simulations.

The majority of modelling work is outside of Government and heavily dependent on the release of unit record tapes by the Australian Bureau of Statistics. Continued release is being questioned.

Government hypothetical and microsimulation modelling covering both benefits and taxes has fallen behind in recent years and the Department of Social Security is designing a new combined model to correct this.

There is no conclusive evidence on the effects of the methodological differences observed in Australian models. Work on accuracy and sensitivity is desirable, particularly if simulation results are to be used in evaluating policy options before Government. Such work will be a necessary part of the development of the DSS Policy Effects Model.

REFERENCES

Apps, Patricia (1988), *Modelling Household Labour Supply and the Welfare Affects of Tax Reforms*, Working Papers in Economics and Econometrics No. 175, Department of Economics Australian National University.

Australian Government Commission of Inquiry into Poverty (1975), *Poverty in Australia, First Main Report of the Commission of Inquiry into Poverty*, Australian Government Publishing Service, Canberra.

Australian Treasury (1985), *Reform of the Australian Tax System: Draft White Paper*, Australian Government Publishing Service, Canberra.

Bradbury, B., Doyle, J., and Whiteford, P. (1990), *Trends in the Disposable Incomes of Australian Families, 1982–83 to 1989–90*, Social Policy Research Centre, Discussion Paper No. 16, University of New South Wales, Kensington.

Edwards, M. (1981), *Financial Arrangements Within Families*, A Research Report to the National Women's Advisory Council, Canberra.

Foster, C. (1988), *Towards a National Retirement Incomes Policy*, Issues Paper No. 6, Social Security Review, Department of Social Security, Canberra.

Perkins, J. (1989), *Patterns of Household Expenditure*, Paper presented to the Econometrics Conference, University of New England, Armidale NSW, July 13-15 1989, National Institute of Economic and Industry Research, Melbourne.

Sutherland, H. (1989), *Constructing a Tax-benefit Model : What Advice Can One Give*, Paper presented at the International Association for Research in Income and Wealth, West Germany, August 1989, Suntory Toyota International Centre for Economics and Related Disciplines, London School of Economics, London.

Warren, N. (1987), *The Distributional Impact of a Change in the Tax Mix in Australia*, Research Study No. 6, Australian Tax Research Foundation, Sydney.

APPENDIX A

DETAILED COMPARISON OF AUSTRALIAN TAX-BENEFIT MODELS

This Appendix contains the detailed results of a survey of Australian tax-benefit models. Appendix B lists papers written from or on the models. In this Appendix, each model is compared on criteria for the ideal Australian static tax-benefit model. The sixteen models covered by the tables of this Appendix have been grouped as follows:

Hypothetical Models

- Department of Social Security Effective Marginal Tax Rates Model written in Basic ('DSS BASIC EMTR')
- Department of Social Security Timeseries Model written in BASIC ('DSS BASIC TIMESERIES')
- Australian Institute of Family Studies model at January 1989 written in PASCAL ('AIFS PASCAL MODEL(JAN89)')
- Economic Planning Advisory Council model for 1988 written in LOTUS 123 ('EPAC LOTUS 1988')

Income Survey Based Static Models

- National Institute of Economic and Industry Research model of annual incomes based on the unit record tape of the Australian Bureau of Statistics Income and Housing Survey for 1981–82 and Income Distribution Survey for 1985–86. Model used during the period 1986—1988. ('NIEIR ANNUAL INCOMES')
- National Institute of Economic and Industry Research model of current incomes based on the unit record tape of the Australian Bureau of Statistics Income and Housing Survey for 1981-82 and Income Distribution Survey for 1985–86. Model used during the period 1986—1988. ('NIEIR CURRENT INCOMES')
- Policy Coordination Unit Model for 1987 based on the unit record tape of the Australian Bureau of Statistics Income and Housing Survey for 1981-82. ('PCU TAX87')
- Australian Institute of Family Studies 'Actuals' Model based on the unit record tape of the Australian Bureau of Statistics Income Distribution Survey for 1985–86. ('AIFS ACTUALS')
- Social Policy Research Centre Tax and Transfer Library of SAS programs using the unit record tape of the Australian Bureau of Statistics Income Distribution Survey for 1985–86. ('SPRC TATLIB')

Expenditure Survey Based Models

- Dr Neil Warren's STATAX model based on the Australian Bureau of Statistics half sample unit record tape of the 1984 Household Expenditure Survey. ('WARREN STATAX')
- The Australian Bureau of Statistics Fiscal Incidence Study based on the full data of the 1984 Household Expenditure Survey. ('ABS FIS')

Combined Hypothetical/Microsimulation Models

- The Centre of Policy Studies combined Spending and Taxing and Tax Modification models based on a database derived from the 1981-82 Income and Housing Survey, the 1984 Household Expenditure Survey and the 1985–86 Income Distribution Survey. This model can also run on synthetic data and is the only existing Australian tax-benefit model which is controlled through pull-down menus. ('COPS SPAT/TAXMOD')

- The planned Department of Social Security Policy Effects Model which will be a hypothetical model combined with a static microsimulator based on the 1988-89 Household Expenditure Survey, the unit record tape of which is due for release in September 1990. The model will be menu-driven with context sensitive help. ('DSS Policy Effects Model')

Utility Function Models

- The Reform of the Australian Tax and Social Security System Project (RATSSS) is a collaboration between Associate Professor Patricia Apps and Dr Elizabeth Savage of the University of Sydney and Dr Glenn Jones of Macquarie University. The project has a *Fixed Incidence Model* and a *Behavioural Model*. Both models are based on estimates of utility functions which include hourly wage rate, hours of work and the tax rate. The utility function results estimated from the cross-sectional data are converted to money measures. The estimation systems are therefore radically different from other Australian microsimulators. The models have been used for many studies of the equity and efficiency effects of changes to the tax system and of alternative systems for modelling the labour supply response of households. The studies are based on the 1981–82 Income and Housing Survey and the 1986 Income Distribution Survey without reweighting, with some economic updating and tax modelling. Relevant studies are listed in Appendix B. ('RATSSS Fixed Incidence Model') ('RATSSS Behavioural Model ')

Micro-Macro Models

- The National Institute for Economic and Industry Research micro to macro model which derives demographic variables explaining expenditure from a twenty year backwards microsimulation based on the 1984 HES and which feeds these equations into the Institute's IMP macro-model for twenty year forward projections of macro-responses to demographic change. ('NIEIR HES/IMP')
- The Institute of Applied Economic and Social Research macro to micro-model which feeds macro-model (ORANI-NAGA) income effects from direct and indirect taxation changes and feeds these into a static micro-simulator based on the 1981-82 Income and Housing Survey in order to examine the distributional consequences. ('IAESR IHS/ORANI')

MODELS NOT COVERED IN THE TABLES

The table layout is unsuitable for dynamic models, administrative data models which do not cover both taxes and benefits, and models not yet under construction. The text of the paper mentions the following Australian models:

Administrative Models

- The Australian Taxation Office has an Individual Taxation Model used for revenue analysis. The data is a sample of individual tax returns lodged and processed within a given tax year. Ageing procedures are still being developed. The model does not cover joint incomes. All tax system parameters can be modelled. Only taxable income security benefits are included in the data and welfare changes are not modelled.
- The Department of Social Security costs complex policy changes for existing clients from unit record sample files. Tax changes and changes for new clients are not modelled. Ad hoc costings of the latter may be attempted from Income Survey unit record tapes.

Dynamic Models

- The National Institute of Economic and Industry Research is constructing a dynamic microsimulator (see the paper by King, Foster and Manning in this volume). Dynamic microsimulators concentrate on the transitional probabilities between life stages and on how these impact on employment and incomes. The simulations are usually much longer than from static models.

  Transitions are modelled in the order of demographic, labour market including superannuation, and the tax-transfer system. Demographic processes modelled include formation of new income units, death, separation/divorce, birth, marriage. Labour market processes modelled include changes in labour market status, change of employment including industry, earnings and superannuation. The tax-transfer model is based on that used in the NIEIR static models.

- Ms Ann Harding of the Department of Social Security is constructing a dynamic microsimulator as part of her studies at the London School of Economics. Transitions modelled include mortality, disability, primary and secondary school, tertiary education, family formation and dissolution, childbirth, labour force participation and unemployment, cash payments and income taxes.

Models being Designed

- Mr Richard Cumpston of the Institute of Applied Economic and Social Research is designing a microsimulator of retirement incomes.

TABLE LAYOUT

Hypothetical Models and Income Survey Based Models each have their own *tables*. HES Based models and Combined Models have a combined table as do Utility Function Models and Micro-Macro models.

All tables except that for hypothetical models are divided into four *sub-tables*:

- Input Requirements;
- Update Requirements (including reweighting);
- Model Coverage; and
- Model Output (which includes comparison of the User and Programmer Interfaces).

The Hypothetical Models table does not have an update requirements sub-table.

These tables cover some 31 pages, and so readers may wish to use the contents table on the next page to find appropriate tables.

The *criteria* listed on the left of each table are generally the preferred requirements for the new Department of Social Security tax-benefit model. However in categories such as Time Series Statistics and Structural Alternatives the stub labels are clearly descriptive and do not reflect any ideal requirement.

Tables Describing Australian Microsimulation Models: Contents

Hypothetical Models: Input Requirements

	DSS BASIC EMTR	DSS BASIC TIMESERIES	AIFS PASCAL MODEL(JAN89)	EPAC LOTUS 1988
GROUPS: DEMOGRAPHIC				
Head Age	Yes- Over 70	No	No	No
Spouse Age	No	No	No	No
Head Sex	No	No	No	No
Spouse sex	No	No	No	No
Children Age	No	No	No	Yes
Head Study Status	No	No	No	No
Spouse Study Status	No	No	No	No
Children Study Status	No	No	No	No
Head Work Status	No	No	No	No
Spouse Work Status	No	No	No	No
Children Work Status	No	No	No	No
Income Unit - Nature of Occupancy	private renters only	Private renters only	Public renters only	
INCOME DATA: SOURCES:				
Current private assessable	IU,Hd/Sps SPLIT	IU	IU, Hd/Sps Split	'=CPT
Current private taxable	'=CPA	No	'=CPA	IU,Hd/Sps, Kids
Current private by detailed source	No	No	No	No
Annual private Assessable	Calculated	No	Yes	'=APA
Annual private taxable	'=APA	IU - Fixed splits	'=APA	IU,Hd,Sps,Kid
Annual separate net income	Calculated	Calculated	Calculated	'=Sps APA
Annual private by detailed source	No	No	No	No
Last year private taxable	No	No	No	No
Parent Taxable Last Year	No	No	No	No
Current GCB- taxable	Calc	No	Calc	No
Current GCB- Non-taxable	Calc	No	Calc	No
Annual GCB- taxable	Not displayed	Not displayed	Calc	No
Annual GCB- Non-taxable	Not displayed	Not displayed	Calc	No
Current Earnings	No	No	No	Yes
Annual Earnings	No	No	No	Yes
Current maintenance	No	No	No	No
Annual maintenance	No	No	No	No
Overseas Pensions	No	No	No	No
Multiples of AWE	No	YES	No	Yes
Multiples of Household Income	No	No	No	No
Multiples of Other Economic Statistic	No	No	No	No
Tax-Benefit Turning Points	YES	No	No	As data-not calc
Income Form:				
Direct measures	No	No	No	No
Updated Measures	No	No	No	No
Projected measures	No	No	No	No
Hypothetical	Yes	AWE for nonDSS	Yes	Yes- AnPY
Income Format:				
Dollars and cents	Yes	For calc- not displayed	For calc	After div 52.14
Single dollars	No	Output	If Range	No
Ranges	Turning Points	No	Yes- displayed	'$500
Mean of ranges	No	No	No	No
EXPENDITURE DATA:				
Detailed by commodity	No	No	No	No
Broad category	No	No	No	No
Current Indirect Taxation Category	No	No	No	No
Future Indirect Taxation Category	No	No	No	No
Format:				
Dollars and cents	na	na	na	na
Dollar Ranges	na	na	na	na
Mean of Ranges	na	na	na	na
REAL ADJUSTMENT				
AW Total E- All Males	Not applicable	No	Not applicable	Not applicable
CPI -8 Capital Cities	na	Yes	na	na
CPI Components	na		na	na
TIME PERIOD	1984 - 1988	1982/83 - 87/88	1982/3-1990/1	30-Jun-88
TIME UNIT	twice per year max	Financial year	Point in time	Point in time
REWEIGHTING STATS	not applicable	not applicable	not applicable	not applicable
UPDATING STATS	not applicable	not applicable	not applicable	not applicable

TAX/BENEFITS COVERED	DSS BASIC EMTR	DSS BASIC TIMESERIES	AIFS PASCAL MODEL(JAN89)	EPAC LOTUS 1988
DSS PAYMENTS & TESTS:				
Age Pension - under 70	Hd+Sps	Hd+Sps	Hd+Sps	Hd+Sps
Age Pension - 70 & over	Hd+Sps	Hd+Sps	No	No
Age Pension- mixed age	No	No	No	No
Wifes Pension- Aged	No- Treat as Couple	No	No	No
Invalid Pension	Yes	Yes	Not sep- as 'pension	Not sep- as 'pension
Wifes pension- Invalid,SEA,Rehab	No- Treat as Couple	No- Treat as Couple	No- Treat as Couple	No- Treat as Couple
Carers Pension	No	No	No	No
Sheltered Employment Allowance	No	No	No	No
Rehabilitation Allowance	No	No	No	No
Mixed Pension - Benefit	No	No	No	No
Couple Living Apart - Medical Reasons	No	No	No	No
Sole Parent's Pension	Yes	As Single AP	Yes	As pension+MGA
Widows Pension Class B	No	No	No	No
Widowed Persons Allowance	No	No	No	No
Unemployment Benefit- Couple	Yes	Yes	Yes	Yes
Unemployment Benefit- Single Adult	Yes	Yes	Yes	Yes
Unemployment Benefit- Sing. 18-20	Yes	NO	No-Can put data in file	No
Job Search Allowance	As Junior UB	No	No	No
Young homeless Allowance	No	No	No	No
Sickness Benefit	Yes	Yes	No	No
Sickness Benefit- age rel rates	As UB	No	No	No
Special Benefit	No	No	No	No
Special Benefit Categories	No	No	No	No
Family Allowance	Yes	Yes	Yes	Yes
Family Allowance Income Test	No	No	Yes	Yes
Family Allowance Supplement	No	No	No-Can put data in file	Yes
Family Income Supplement	Yes	Yes	Yes	No
Multiple Births Payments	No	No	No	No
Child Disability Allowance	No	No	No	No
Mobility Allowance	No	No	No	No
Remote Area Allowance	No	No	No	No
Additional Pen/Ben Children-any age	Yes	Yes	Yes	No
Additional Pen/Ben Children-age rel	No	No	No-Can put data in file	Yes
Mother's /Guardians Allowance	Yes	Yes	Yes	Yes
Rent Assistance	Yes	Yes	Yes	Yes
Children's Income Testing	No	No	No	No- but KY in data
Assets Test on Anything	No	No	No	No
Liquid Assets Tests	No	No	No	No
Earnings Credits	No	No	No	No
VETERANS AFFAIRS PAYMENTS:				
Service Pension	No	No	No	No
Disability pension- Special	No	No	No	No
Disability pension- Intermediate	No	No	No	No
Disability pension- General	No	No	No	No
Extreme Disablement Allowance	No	No	No	No
War & Defence Widows Pension	No	No	No	No
Domestic Allowance	No	No	No	No
Orphans Pension	No	No	No	No
Attendant Allowance	No	No	No	No
Clothing Allowance	No	No	No	No
Section 27 Increased rate> 1-6	No	No	No	No
Section 27 Increased rate> 7-15	No	No	No	No
Recreational Transport Allowance	No	No	No	No
Vehicle Assistance Allowance	No	No	No	No
Veteran's Children Education Scheme	No	No	No	No
Guardian's Allowance	No	No	No	No
Additional Pension for Children	No	No	No	No
Rent Assistance	No	No	No	No
Remote Area Allowance	No	No	No	No
MIXED DVA/DSS PAYMENT	No	No	No	No

TAX/BENEFITS COVERED	DSS BASIC EMTR	DSS BASIC TIMESERIES	AIFS PASCAL MODEL(JAN89)	EPAC LOTUS 1988
DEPARTMENT OF EMPLOYMENT, EDUCATION, & TRAINING				
AUSTUDY	No	No	No	No
ABSTUDY	No	No	No	No
Assistance For Isolated Children	No	No	No	No
Formal Training Allowance	No	No	No	No
Fares Assistance Scheme	No	No	No	No
JOBSTART (subsidy)	No	No	No	No
CRAFT living away from home allow'ce	No	No	No	No
CRAFT (subsidy)	No	No	No	No
Higher Education Contribution Scheme	No	No	No	No
- Upfront payment	No	No	No	No
	No	No	No	No
Parental Income Tests	No	No	No	No
Independence Tests	No	No	No	No
Assets Tests	No	No	No	No
DEPARTMENT OF COMMUNITY SERVICES AND HEALTH				
Disadvantaged Persons Health Schm	No	No	No	No
Pensioner Health Benefits	No	No	No	No
Pensioner Pharmaceutical Benefits	No	No	No	No
Health Care Card benefits	No	No	No	No
Health Benefits Card	No	No	No	No
General Pharmaceutical Benefits	No	No	No	No
Nursing Home Benefit	No	No	No	No
Hearing Services	No	No	No	No
First Home Owners Scheme	No	No	No	No
Emergency Relief	No	No	No	No
Child Care Fee Relief	No	No	YES**********	No
STATE HOUSING AUTHORITIES				
Public Rent Rebates	No	No	YES **** (Vic)	No
Mortgage & Rent relief	No	No	No	No
Low Interest & Special Mortgages	No	No	No	No
Home equity conversions	No	No	No	No
Local & Community Housing	No	No	No	No
OTHER AUTHORITIES				
Telephone concessions	No	No	No	No
Transport concessions	No	No	No	No
Rate concessions	No	No	No	No
Electricity & Gas rebates	No	No	No	No
Health Services- free or reduced cost	No	No	No	No
Student allowances	No	No	No	No
Other education concessions	No	No	No	No

TAX/BENEFITS COVERED	DSS BASIC EMTR	DSS BASIC TIMESERIES	AIFS PASCAL MODEL(JAN89)	EPAC LOTUS 1988
INCOME TAXATION				
PAYE tax	Yes	Yes	Yes	Yes
Provisional Tax	No	No	No	No
Prescribed Payments Scheme	No	No	No	No
Capital Gains Tax	No	No	No	No
Partnerships	No	No	No	No
Trusts	No	No	No	No
Medicare Levy	Yes	No	Yes	Yes
Retirement Income Taxation	No	No	No	No
Superannuation Fund Taxation	No	No	No	No
Non-retirement termination payments	No	No	No	No
Leave Bonus	No	No	No	No
Dividend imputation	No	No	No	No
Income Averaging schemes	No	No	No	No
Business Income Deductions	No	No	No	Yes
Other deductions	No	No	No	Yes
Primary producer Av'g & deductions	No	No	No	No
Taxation of Minors	No	No	No	No
Part-year taxation	No	No	No	No
CHILD SUPPORT	No	No	No	No
HIGHER EDUCATION CONTRIBUTIONS SCHEME- arrears	No	No	No	No
Dependant Spouse Rebate	Yes	Yes	Yes	Yes
Other Dependant rebates-Hskpr etc	No	No	No	No
Sole Parent Rebate	Yes	Yes	Yes	Yes
Pensioner Rebate	Yes	Yes	Yes	Yes
Beneficiary Rebate	Yes	Yes	Yes	Yes
Zone rebates	No	No	No	No
Medical Expenses rebate	No	No	No	No
Tax Expenditures	No	No	No	No
INDIRECT TAXATION				
Wholesale Sales Tax	No	No	No	No
	No	No	No	No
Payroll tax	No	No	No	No
Taxes on Immovable Property	No	No	No	No
Estate, Inheritance & Gift Duties	No	No	No	No
Financial & Capital transaction taxes	No	No	No	No
Excises on petroleum products	No	No	No	No
Excises on beer and potable spirits	No	No	No	No
Excises on tobacco products	No	No	No	No
Other excises	No	No	No	No
Customs duties	No	No	No	No
Taxes on gambling	No	No	No	No
Taxes on Insurance	No	No	No	No
Motor Vehicle taxes	No	No	No	No
Franchise taxes	No	No	No	No
Departure tax	No	No	No	No
Broadcasting licences	No	No	No	No
Fees & Fines	No	No	No	No
COVERAGE UNITS				
Household	na	na	na	na
Family	na	na	na	na
Income Unit	DSS, Inc Tax	DSS, Inc Tax	DSS, Inc Tax	DSS, Inc Tax
IU Head	Calc- not displayed	Calc- not displayed	DSS, Inc Tax	DSS, Inc Tax
IU Spouse	Calc- not displayed	Calc- not displayed	DSS, Inc Tax	DSS, Inc Tax
Children	na	na	na	na
Derived/Imputed	From Private Income	From Private Income	From Private Income	From Private Income

Hypothetical Models: Output

VARIABLES/FORMATS COVERED	DSS BASIC EMTR	DSS BASIC TIMESERIES	AIFS PASCAL MODEL(JAN89)	EPAC LOTUS 1988
ANALYTIC VARIABLES:				
Gross income	Calc- not displayed	Not output	No	Yes
Gross income - Business deductions	No	No	No	Yes
Gross income - Other tax deductions	No	No	No	Yes
Gross income accruing	No	No	No	No
DSS income as assessed	No	No- assumes=0	No	No
Gross income after child care	No	No	No	No
Gross income after housing costs	No	No	No	No
Separate net income	Calc- not displayed	Calc- not displayed	Calc- not displayed	Not displayed
Total rebates	Calc- not displayed	Yes	Yes	Yes
Gross medicare levy	Calc- not displayed	NO	No	Yes
Net medicare levy	Calc- not displayed	NO!!	Yes	Yes
Gross tax	Calc- not displayed	Calc- not displayed	Yes	Yes
Net tax	Calc- not displayed	Yes -w&wo FA	Yes	Yes
Rebates unused	No	No	No	No
Disposable income (ie after tax)	Yes	Yes	Yes	No
Disposable income after housing	No	No	Yes	No
Disposable income after child care	No	No	Yes	No
Disp. inc. after hsg & child care	No	No	Yes	No
Equivalent disposable incomes:				
- Simplified Henderson	No	No	No	No
- Detailed Henderson before hsq	No	No	No	No
- Detailed Henderson after hsq	No	No	No	No
-ABS	No	No	No	No
-OECD	No	No	No	No
-Whiteford Geometric Mean	No	No	No	No
- Swedish	No	No	No	No
Poverty Line on AWE	No	No	No	No
Poverty Line on HDI	No	No	No	No
Point Marginal Rates	No	No	No	Yes ********
Effective Marginal Tax Rates:				
- After Inc Tax & DSS (1)	Yes	Yes	IU & Hd or Sps	IU+Hd+Sps
- After IT&SS & Child Care (2)	No	No	IU & Hd or Sps	No
- After IT&SS&CC & Hsg (3)	No	No	IU & Hd or Sps	No
- After above (n) & Health (4)	No	No	No	No
- After above (n) & Indirect tax (5	No	No	No	No
Average Tax Rates-which of above	Not calc	One	No	None
Net Tax Liability- FA as credit	No	Yes	No	No
Net Tax/Benefit Liability	No	No	No	No
Expenditure taxation	No	No	No	No
Total expenditure	No	No	No	No
Apparent savings	No	No	No	No
Total tax incidence	No	No	No	No
Quantile Types available	None	None	None	None
Distributional Statistics Available	None	None	None	None

VARIABLES/FORMATS COVERED	DSS BASIC EMTR	DSS BASIC TIMESERIES	AIFS PASCAL MODEL(JAN89)	EPAC LOTUS 1988
TIME SERIES STATISTICS:				
Real Incomes - CPI	na	Yes	na	na
Real Incomes - CPI components	na	No	na	na
Real Incomes - AWT E- All Males	na	Base-no/numerator-yes	na	na
Real Inc. - AWT E- All M. Nov Svy	na	No	na	na
Real Inc. - HDI PCap	na	No	na	na
Real Inc. - HI PCap	na	No	na	na
DSS Income Index	na	Yes	na	na
Disposable Income Index	na	Yes	na	na
Nominal/ Real Conversion	na	Yes	na	na
Change of base year	na	Yes	na	na
IMPACT ANALYSIS:				
Costings of parameter change	No	No	No	No
Costings of structural change	No	No	No	No
Winners/Losers Parameter Change	No	No	No	No
Winners/Losers Structural Change	No	No	No	No
Behavioral Response Par. Change	No	No	No	No
Behavioral Response Str. Change	No	No	No	No
STRUCTURAL ALTERNATIVES:				
Refundable tax credits	No	No	No	No
Other tax credits	No	No	No	No
Low income rebates	Yes	Yes	Yes	No
Child rebates	Yes- as add on to LIR	Yes	Yes	No
Child care rebates	No	No	Yes	No
Medicare - Maximum Levy	Yes	No	No	No
Consumption taxes	No	No	No	No
Income test on sole parent rebate	Yes	No	No	No
Tax family allowances on joint income	Yes	No	No	Yes
Income test DSR on family income	Yes	No	No	No
Diff threshold for second earner	Yes	No	No	No
Lower threshold for FA recipient	Yes	No	No	No
Low income rebates by family type	Yes	Yes	Yes	No
Non-stand. Low Income Supplements	Yes	No	No	No
Extra rent assistance for kids	Yes	No	No	No
Change tax on any payment	Yes	Yes	No	No
New payments	See above	No	No	No
Savings clauses	Frozen rate	No	No	No
Earnings credits	No	No	No	No
Income test exemptions	Yes	No	No	No
Separate inctest on RA	Yes	No	No	Yes
Tax exemption level not thresh	No	Yes	No	No
General surcharge/rebate	No	Yes	No	No
Over Seventies arrangements	Yes	No	No	No
Income Splitting			Yes	
Family Rebate			Yes	
Negative Tax			Yes	

Hypothetical Models: Output

VARIABLES/FORMATS COVERED	DSS BASIC EMTR	DSS BASIC TIMESERIES	AIFS PASCAL MODEL(JAN89)	EPAC LOTUS 1988
OUTPUT:				
Medium	Screen+ Paper	Screen+ Paper	Paper only	Screen+Paper
Format	Tables	Tables	Tables	Tables+Graphs
Direct Comparison	No	No	No	No
USER INTERFACE:				
Menu driven	Yes- as is only recall	Yes- as is only recall	Input selection only	Set flags on first scrn
Parameter change method	Change text display	Change text display	Text file or scrn option	Spreadsheet
Parameter change time	'24 hours update	'24 hours update	Instantaneous	Instantaneous
Structural alternatives method	Edit one/two par files	Edit par file	Change program	Change program
PROGRAMMER INTERFACE:				
Machine	WANG PC S3-2	WANG PC S3-2	Prime+IBM+Mac	IBM compat
Language/ Software	WANG BASIC	WANG BASIC	Pascal+Spreadsheets	LOTUS123
Record Format - data	Strings	Strings	User specified	Spreadsheet
Record Format - parameters	Strings	Strings	Text files	Spreadsheet
Memory Management	Strings to minimise	Strings to minimise		
Reasons for choosing hardware	Availability	Availability		
Reasons for choosing software			Good+Structured	Familiarity

Income Survey Based Static Models : Input Requirements

	NIEIR Annual Incomes	NIEIR Current Incomes	PCU TAX87	AIFS ACTUALS	SPRC TATLIB
DATA SOURCE	81-82 IHS, 86 IDS	81-82 IHS, 86 IDS	81-82 Inc & Hsg Svy	1985-86 Inc Distn Svy	1985-86 Inc Distn Svy
MODEL TYPE	Static	Static	Static	Static	Static
GROUPS: DEMOGRAPHIC					
Head Age	Yes	Yes	Yes	Yes	Yes
Spouse Age	Yes	Yes	Yes	Yes	Yes
Head Sex	Yes	Yes	Yes	Yes	Yes
Spouse sex	Yes	Yes	Yes	Yes	Yes
Children Age	No	No	Yes	Yes	Yes
Head Study Status	Yes	Yes	Yes	Yes	Yes
Spouse Study Status	Yes	Yes	Yes	Yes	Yes
Children Study Status	Records deleted if dep	Records deleted if dep	Records deleted		
Head Work Status	Yes	Yes	Yes	Yes	Yes
Spouse Work Status	Yes	Yes	Yes	Yes	Yes
Children Work Status	Records deleted if dep	Records deleted if dep	Records deleted		
Income Unit - Nature of Occupancy	Yes- renters not split	public/private in 86	Yes	Renters not split	Renters not split
Household Person counts	If required	If required	Yes		
INCOME DATA:					
SOURCES:					
Current private assessable	No	Imputed	HH,IU,Hd,Sps		
Current private taxable	No	Imputed	HH,IU,Hd,Sps		
Current private by detailed source	No	Hd, Sps from source	HH,IU,Hd,Sps		
Annual private Assessable	Imputed	x52 (for tax)	HH,IU,Hd,Sps	Used	Imputed
Annual private taxable	Imputed	x52 (for tax)	HH,IU,Hd,Sps	Used	Imputed
Annual separate net income	Imputed	x52 (for tax)	Imputed	Imputed	Imputed
Annual private by detailed source	Hd, Sps from source	Hd, Sps from source	HH,IU,Hd,Sps	Used	Used
Last year private taxable	No	No	Period is last year		
Parent Taxable Last Year	No	No	No		
Current GCB- taxable	No	Imputed & Source	Imputed		
Current GCB- Non-taxable	No	Imputed & Source	Imputed		
Annual GCB- taxable	Imputed & Source	x52 (for tax)	Imputed	Impute	By decomposition
Annual GCB- Non-taxable	Imputed & Source	x52 (for tax)	Imputed	Impute	By decomposition
Current Earnings	No	Yes	Yes		
Annual Earnings	Yes	No	Yes	Used	Used
Current maintenance	No	Yes	Yes		
Annual maintenance	Yes	No	Yes	Used	?
Overseas Pensions	In 'other pensions'	In 'other pensions'	No	No	No
Income Form:					
Direct measures	Yes	Yes			
Updated Measures	Yes	Yes	Yes	Yes	Yes
Projected measures	Yes	Yes	Yes	Yes	
Hypothetical	No	No	No		
Income Format:					
Dollars and cents	Yes	Yes	Yes	Yes	Yes
Single dollars	No	No	No		
Ranges	No	No	No		
Mean of ranges	No	No	No		
EXPENDITURE DATA:					
Detailed by commodity	Only housing	Housing& Concessions	No (hsg only)	No	Housing imputed
Broad category	No	No	No	No	No
Current Indirect Taxation Category	No	No	No	No	No
Future Indirect Taxation Category	No	No	No	No	No
Format:					
Dollars and cents	Yes	Yes	na	na	na
Dollar Ranges	No	No	na	na	
Mean of Ranges	No	No	na	na	
TIME PERIOD	81/2-85/6 1986-2006	July 1982 to July 1987	'July 1986 & July 1987	1985-86 to 1990-91	1982/3 and 1989/90
TIME UNIT	Annual	July each year	Point in time	Financial Year	Two financial years

Income Survey Based Static Models : Update Requirements

	NIEIR Annual Incomes	NIEIR Current Incomes	PCU TAX87	AIFS ACTUALS	SPRC TATLIB
PRIVATE INCOMES UPDATE:					
Wages and Salaries	Wkly Earngs (August)	Wkly Earngs (August)	AWE WT All males/fem	AWE	Combined Index
Self-employment	NA unincorp* Industry	NA unincorp* Industry	AWE WT All males	AWE	NA based Index
Interest	NA other interest rcvd	NA other interest rcvd	Left constant	AWE	NA other interest rcvd
Dividends	NA- Dividends rcvd	NA- Dividends rcvd	Left constant	AWE	NA- Dividends rcvd
Rent	CPI - Private rent comp	CPI - Private rent comp	CPI - Private rent comp	AWE	CPI - Private rent comp
Superannuation	Wkly Earngs (August)	Wkly Earngs (August)	AWE WT All males	AWE	CPI
Worker's compensation	Wkly Earngs (August)	Wkly Earngs (August)	AWE WT All males	AWE	CPI
Maintenance and alimony	Survey & Admin data	Survey & Admin data	CPI	Assumed Constant	CPI
Income from other source	NA- Houseshld Income	NA- Houseshld Income	CPI	AWE	CPI
Private Income Projection Assumption	NIEIR or client	NIEIR or client	na	???	
GOVERNMENT CASH BENEFITS:					
Annual amount	Yes - where imputed	No	Yes	Yes	Yes
Weekly amount		Yes	Yes	No	No
Overseas pensions- direct deductions	No	No	No	No	No
Age Pension	File elig & rel. index	Impute elig + $	File weeks* imputed $	File elig & CPI index	File elig& Compon indx
Invalid Pension	File elig & rel. index	File elig + impute $	File weeks* imputed $	File elig & CPI index	File elig& Compon indx
Widow's Class A	File elig & rel. index	Impute elig + $	File weeks* imputed $	File elig & CPI index	File elig& Compon indx
Widow's Class B	File elig & rel. index	Impute elig + $	File weeks* imputed $	File elig & CPI index	File elig& Compon indx
Supporting Parent's Benefit	File elig & rel. index	Impute elig + $	File weeks* imputed $	File elig & CPI index	File elig& Compon indx
Wifes Pension	File elig & rel. index	As Age Pen couple	File weeks* imputed $	File elig & CPI index	File elig& Compon indx
'Other' Pension	File elig & rel. index	File elig + impute $	Imputed as Spec Ben	File elig & CPI index	File elig& Compon indx
Unemployment Benefit	File elig & rel. index	Impute elig + $	File weeks* imputed $	File elig & CPI index	File elig& Compon indx
Sickness Benefit	File elig & rel. index	File elig + impute $	File weeks* imputed $	File elig & CPI index	File elig& Compon indx
Special Benefit	File elig & rel. index	File elig& impute$ for 8	From 'other' pension	?	File elig& Compon indx
Family Allowances	File elig & rel. index	File elig + impute $	File elig + impute $	Use income test	File elig& Compon indx
Family Income Supplement	Impute elig., takeup & $	Imp takeup adj elig & $	Impute elig + $	na	Imp takeup adj elig & $
Family Allowance Supplement	Impute elig., takeup & $	Imp takeup adj elig & $	na	Use income test	Imp takeup adj elig & $
Veterans Affairs Payments	File elig & rel. index	File Elig+pension index	File weeks* imputed $	File elig & CPI index	Pay index
Mixed DSS/DVA	File elig & rel. index	File Elig+pension index	File elig	File elig & CPI index	Pay index
Education Allowances 16-17 yr olds	File elig & rel. index	File elig + paymt index	File elig + paymt index	AUSTUDY inc test	?
Education Allowances 18+ yrs	File elig & rel. index	File elig + paymt index	File elig + paymt index	AUSTUDY inc test	?
Married pension split method	1/2 IU pay, APC to Sps	1/2 IU pay, APC to Sps	Indiv $-Half of IU redn	Half of IU payment	Not stated
INCOME TAXATION					
Non-taxable GCBs	Removed	Removed	removed	Removed	Component split methd
Maintenance	Removed for females	Removed for females	Removed	Removed	
Deductions	TI* 0.03	TI* 0.03	No	Regression model	Mn Ded x Inc Cat / 3%
Dependent spouse rebate	Imputed	Imputed	Imputed	Imputed	Imputed
Sole Parent Rebate	Imputed	Imputed	Imputed	Imputed	Imputed
Pensioner and beneficiary rebate	Imputed	Imputed	Imputed	Imputed	Imputed
"Other" rebates	TI*0.005 (pre-Medicare	,different post-Medicare	No		
Separate net income	TI-FA-FIS	TI-FA-FIS	wty+wip+wwwd+adpb	Imputed	Imputed
Medicare levy	Imputed	Imputed	Imputed	Imputed	Imputed
REWEIGHTING	(!=Single Index, #=Cross Classified)				
Age by Gender	Pop Projections #	Pop Projections #			Method 1#
Marital Status	LFS prop #	LFS prop #	LFS prop GCB num#	LFS #	Method 1#
Labour force status	LFS #	LFS #	LFS prop GCB num #	LFS #	Methods 1 & 2#
Sole Parents	Not sep included	Not sep included	LFSprop GCBnum #	LFS !	Method 2 #
Government cash beneficiaries	Yes	No	DSS + DVA +Edu #		No
Taxpayers	No	No			No
Gender			Pop Proj #	LFS #	M2 for p-weights
Dependants				Working on from LFS#	Method 2 #
Method	3 stage - demog, labour market, DSS	4 dim matrix derived frc LFS & Population Projections	(Proj – GCB)*LFS prop	Past-LFS Proj*LFS%	M1- age,gender,lfs M2- family statusxlfs IU wts as mean P-wts

Income Survey Based Static Models : Coverage (page 1 of 3)

TAX/BENEFITS COVERED	NIEIR Annual Incomes	NIEIR Current Incomes	PCU TAX87	AIFS ACTUALS	SPRC TATLIB
DSS PAYMENTS & TESTS:					
Age Pension - under 70	Yes	Yes	Yes	Yes	Yes
Age Pension - 70 & over	Yes	Yes	No	Yes	Yes
Age Pension- mixed age	No	No	No	No	?
Wifes Pension- Aged	Treat as AP couple	Treat as AP couple	Treat as AP couple	Treat as AP couple	
Invalid Pension	Yes	Yes	Yes	Yes	Yes
Wifes pension- Invalid,SEA,Rehab	(Treat as Invalid or	other pension couple)	Treat as IP couple	No	No
Carers Pension	Other pension	Other pension	No	No	No
Sheltered Employment Allowance	Other pension	Other pension	No	No	No
Rehabilitation Allowance	Other pension	Other pension	No	No	No
Mixed Pension - Benefit	No	No	In year OK	No	No
Couple Living Apart - Medical Reasons	No	No	No	No	No
Sole Parent's Pension	Yes	Yes	As SPB	Yes	Yes
Widows Pension Class B	Yes	Yes	Yes	Yes	Yes
Widowed Persons Allowance	No	No	Yes	No	No
Unemployment Benefit- Couple	Yes	Yes	Yes	Yes	Yes
Unemployment Benefit- Single Adult	Yes	Yes	Yes	Yes	Yes
Unemployment Benefit- Sing. 18-20	Yes	Yes	Yes	Yes	Yes
Job Search Allowance	Yes	Yes	As junior UB	No	?
Young homeless Allowance	No	No	No	No	No
Sickness Benefit	Yes	Yes	Yes	Yes	Yes
Sickness Benefit- age rel rates	Yes	Yes	No	No	No
Special Benefit	Yes from 86 IDS	Yes from 86 IDS	from 'Other Pension'	No	No
Special Benefit Categories	No	No	No	No	No
Family Allowance	Yes	Yes	Yes	Yes	Yes
Family Allowance Income Test	Yes	Yes	na	Yes	Yes
Family Allowance Supplement	Yes	Yes	Yes	Yes	Yes
Family Income Supplement	Yes	Yes	Yes impute		Yes
Multiple Births Payments	No	No	No	No	No
Child Disability Allowance	Yes from 86 IDS	Yes from 86 IDS	No	No	No
Mobility Allowance	No	No	No	No	No
Remote Area Allowance	No	No		No	No
Additional Pen/Ben Children-any age	Yes	Yes	Yes	Yes	Yes
Additional Pen/Ben Children-age rel	Yes	Yes	na	Yes	Yes
Mother's /Guardians Allowance	Yes	Yes	Yes	Yes -imputed	Component split
Rent Assistance	Yes	Yes	Yes	No	Component split
Children's Income Testing	No	No	No	No	No
Assets Test on Anything	No-except FAS takeup	No-except FAS takeup	No	No	No
Liquid Assets Tests	No	No	No	No	No
Earnings Credits	No	No	No	No	No
VETERANS AFFAIRS PAYMENTS:					
Service Pension	Treat as part WDP	Yes	Treat as part WDP	Yes	Not distinguished
Disability pension- Special	Yes- sep using 86 IDS	Yes- sep using 86 IDS	Treat as part WDP	Yes	Not distinguished
Disability pension- Intermediate	Yes- sep using 86 IDS	Yes- sep using 86 IDS	No	Yes	Not distinguished
Disability pension- General	Yes- sep using 86 IDS	Yes- sep using 86 IDS	No	Yes	Not distinguished
Extreme Disablement Allowance	No	No	No	No	Not distinguished
War & Defence Widows Pension	Yes	Yes	Yes	Yes	Not distinguished
Domestic Allowance	No	No	No	No	Not distinguished
Orphans Pension	No	No	No	No	Not distinguished
Attendant Allowance	No	No	No	No	Not distinguished
Clothing Allowance	No	No	No	No	Not distinguished
Section 27 Increased rate> 1-6	No	No	No	No	Not distinguished
Section 27 Increased rate> 7-15	No	No	No	No	Not distinguished
Recreational Transport Allowance	No	No	No	No	Not distinguished
Vehicle Assistance Allowance	No	No	No	No	Not distinguished
Veteran's Children Education Scheme	If showed as Edu Pay	If showed as Edu Pay	If showed as Edu Pay		Not distinguished
Guardian's Allowance	Yes - not sep	Yes - not sep	Yes	Yes	Not distinguished
Additional Pension for Children	Yes - not sep	Yes - not sep	Yes	Yes	Not distinguished
Rent Assistance	Yes - not sep	Yes - not sep	Yes	No	Not distinguished
Remote Area Allowance	No	No	No	No	Not distinguished
MIXED DVA/DSS PAYMENT	Yes	Yes	Yes- file elig	Yes - file elig	Not distinguished

Income Survey Based Static Models : Coverage

TAX/BENEFITS COVERED	NIEIR Annual Incomes	NIEIR Current Incomes	PCU TAX87	AIFS ACTUALS	SPRC TATLIB
DEPARTMENT OF EMPLOYMENT, EDUCATION , & TRAINING					
AUSTUDY	No	Indexes TEAS &CEA	Indexes TEAS &CEA	Impute 16-17 yr olds	?
ABSTUDY	No	No	No	No	No
Assistance For Isolated Children	No	No	No	No	No
Formal Training Allowance	No	No	No	No	No
Fares Assistance Scheme	No	No	No	No	No
JOBSTART (subsidy)	No	No	No	No	No
CRAFT living away from home allow'c	No	No	No	No	No
CRAFT (subsidy)	No	No	No	No	No
Higher Education Contribution Scheme					
- Upfront payment	No	No	No	No	No
				No	No
Parental Income Tests	No	No	No	Yes - if at home	No
Independence Tests	No	No	No	No	No
Assets Tests	No	No	No	No	No
DEPARTMENT OF COMMUNITY SERVICES AND HEALTH					
Disadvantaged Persons Health Schm	No	Yes	No	No	No
Pensioner Health Benefits	No	Yes	No	No	No
Pensioner Pharmaceutical Benefits	No		No	No	No
Health Care Card benefits	No	Yes	No	No	No
Health Benefits Card	No	Yes	No	No	No
General Pharmaceutical Benefits	No	No	No	No	No
Nursing Home Benefit	No	No	No	No	No
Hearing Services	No	No	No	No	No
First Home Owners Scheme	No	No	No	No	No
Emergency Relief	No	No	No	No	No
Child Care Fee Relief	No	No	No	No	No
STATE HOUSING AUTHORITIES					
Public Rent Rebates	No	No	No	No	No
Mortgage & Rent relief	No	No	No	No	No
Low Interest & Special Mortgages	No	No	No	No	No
Home equity conversions	No	No	No	No	No
Local & Community Housing	No	No	No	No	No
OTHER AUTHORITIES					
Telephone concessions	No	No	No	No	No
Transport concessions	No	Yes	No	No	No
Rate concessions	No	Yes	No	No	No
Electricity & Gas rebates	No	Yes	No	No	No
Health Services- free or reduced cost	No	No	No	No	No
Student allowances	No	Yes	No	No	No
Other education concessions	No	No	No	No	No
Motor registration concessions	No	Yes	No	No	No

Income Survey Based Static Models : Coverage (page 3 of 3)

TAX/BENEFITS COVERED	NIEIR Annual Incomes	NIEIR Current Incomes	PCU TAX87	AIFS ACTUALS	SPRC TATLIB
INCOME TAXATION					
PAYE tax	Yes	Yes	Yes	Yes	Yes
Provisional Tax	No	No	No	No	No
Prescribed Payments Scheme	No	No	No	No	No
Capital Gains Tax	No	No	No	No	No
Partnerships	No	No	No	No	No
Trusts	No	No	No	No	No
Medicare Levy	Yes	Yes	Yes	Yes	Yes
Retirement Income Taxation	No	No	No	No	No
Superannuation Fund Taxation	No	No	No	No	No
Non-retirement termination payments	No	No	No	No	No
Leave Bonus	No	No	No	No	No
Dividend Imputation	No	No	No	No	No
Income Averaging schemes	No	No	No	No	No
Business Income Deductions	No	No	No	No	No
Other deductions	Yes	Yes	No	Yes	Yes
Primary producer Av'g & deductions	No	No	No	No	No
Taxation of Minors	No	No	No	No	No
Part-year taxation	No	No	No	No	No
CHILD SUPPORT					
HIGHER EDUCATION CONTRIBUTIONS SCHEME- arrears	No	No	No	No	No
Dependant Spouse Rebate	Yes	Yes	Yes	Yes	Yes
Other Dependant rebates-Hskpr etc	No	No	No	No	No
Sole Parent Rebate	Yes	Yes	Yes	Yes	Yes
Pensioner Rebate	Yes	Yes	Yes	Yes	Yes
Beneficiary Rebate	Yes	Yes	Yes	Yes	Yes
Zone rebates	No	No	No	No	No
Medical Expenses rebate	No	No	No	No	No
Tax Expenditures	No	No	No	No	No
INDIRECT TAXATION					
Wholesale Sales Tax	No	No	No	No	No
Payroll tax	No	No	No	No	No
Taxes on Immovable Property	No	No	No	No	No
Estate, Inheritance & Gift Duties	No	No	No	No	No
Financial & Capital transaction taxes	No	No	No	No	No
Excises on petroleum products	No	No	No	No	No
Excises on beer and potable spirits	No	No	No	No	No
Excises on tobacco products	No	No	No	No	No
Other excises	No	No	No	No	No
Customs duties	No	No	No	No	No
Taxes on gambling	No	No	No	No	No
Taxes on insurance	No	No	No	No	No
Motor Vehicle taxes	No	Value rego concessn	No	No	No
Franchise taxes	No	No	No	No	No
Departure tax	No	No	No	No	No
Broadcasting licences	No	No	No	No	No
Fees & Fines	No	No	No	No	No
COVERAGE UNITS					
Household	Yes	Yes	Yes		
Family	No	No	No		
Income Unit	Yes	Yes	Yes	Yes	Yes
IU Head	Yes	Yes	Yes	Yes	Yes
IU Spouse	Yes	Yes	Yes	Yes	Yes
Children	No	No	No	No	

Income Survey Based Static Models : Output (page 1 of 3)

VARIABLES/FORMATS COVERED	NIEIR Annual Incomes	NIEIR Current Incomes	PCU TAX87	AIFS ACTUALS	SPRC TATLIB
ANALYTIC VARIABLES:					
Gross Income	Yes	Yes	Yes	Yes	Yes
Gross Income - Business deductions	No	No	No	No	
Gross income - Other tax deductions	Yes	Yes	No	Yes - Regression mod	Yes
Gross income accruing	No	No	No	No	No
DSS Income as assessed	Yes- not diff by source	Yes- not diff by source	Yes	No	No
Gross Income after child care	No	No	No	No?	No
Gross Income after housing costs	No	No	No	No	Possible
Separate net income	Yes	Yes	Yes	Yes- Imputed	Yes
Total rebates	Yes	Yes	Yes	Yes	Yes
Gross medicare levy	No	No	Yes	Yes	Yes
Net medicare levy	Yes	Yes	No Hd--Sps transfer	Yes	Yes
Gross tax	Yes	Yes	Yes	Yes	
Net tax	Yes	Yes	Yes	Yes	Yes
Rebates unused	Yes	Yes	Yes	?	
Disposable income (ie after tax)	Yes	Yes	Yes	Yes	Yes
Disposable income after housing	Yes	Yes	Yes	No	Yes
Disposable income after child care	No	No	No	No	No
Disp. Inc. after hsg & child care	No	No	No	No	No
Equivalent disposable incomes:					
- Simplified Henderson	No	No	Yes		No
- Detailed Henderson before hsq	Yes	Yes	Yes	Yes	Yes
- Detailed Henderson after hsq	Yes	Yes	Yes		No
-ABS	No	No	Yes		No
-OECD	No	No	No		No
-Whiteford Geometric Mean	No	No	Yes		No
- Swedish	No	No	No		No
Poverty Line on AWE	Yes	Yes	No		No
Poverty Line on HDI	Yes	Yes	Yes	Yes	No
Point Marginal Rates	Direct output if requirec	Direct output if requirec	No		No
Effective Marginal Tax Rates:					
- After Inc Tax & DSS (1)	Direct output if requirec	Direct output if requirec	No		Planned
- After IT&SS & Child Care (2)	No	No	No		No
- After IT&SS&CC & Hsg (3)	No	No	No		No
- After above (n) & Health (4)	No	No	No		No
- After above (n) & Indirect tax (5)	No	No	No		No
Average Tax Rates-which of above	One	One	No		
Net Tax Liability- FA as credit	Direct output if requirec	Direct output if requirec	No		No
Net Tax/Benefit Liability	Yes	Yes	No		No
Expenditure taxation	No	No	No	No	No
Total expenditure	No	No	No	No	No
Apparent savings	No	No	No	No	No
Total tax incidence	No	No	No	No	No
Quantile Types available	Whatever reqired	Whatever reqired	None used	Quartile	Percentiles
Distributional Statistics Available	Gini, Shorrocks	Gini, Shorrocks	None used	Ranges AWE	

VARIABLES/FORMATS COVERED	NIEIR Annual Incomes	NIEIR Current Incomes	PCU TAX87	AIFS ACTUALS	SPRC TATLIB
TIME SERIES STATISTICS:					
Gross Income	Yes	Yes	na	Yes	Yes
Disposable Incomes	Yes	Yes	na	Yes	Yes
Gov Cash Benefit Incomes	Yes	Yes	na	Yes	Yes
Takeup and cost of State concessions	No	Yes	No		
Housing affordability projections	Yes	No	No		Yes
Real Incomes - CPI	Possible-not standard?	Possible-not standard?	na	No	
Real Incomes - CPI components	Not standard output	Not standard output	na		
Real Incomes - AWT E- All Males	Not standard output	Not standard output	na		
Real Inc. - AWT E- All M. Nov Svy	Not standard output	Not standard output	na		
Real Inc. - HDI PCap	Not standard output	Not standard output	na		
Real Inc. - HI PCap	Not standard output	Not standard output	na		
DSS Income Index	Not standard output	Not standard output	na		
Disposable Income Index	Not standard output	Not standard output	na		
Nominal/ Real Conversion	Not standard output	Not standard output	na		
Change of base year	Not standard output	Not standard output	na		
IMPACT ANALYSIS:					
Costings of parameter change	Yes	Yes	Yes	Yes	Yes
Costings of structural change	Yes	Yes	Yes	Yes	Yes
Winners/Losers Parameter Change	Yes	Yes	Yes	Yes	Yes
Winners/Losers Structural Change	Yes	Yes	Yes	Yes	Yes
Behavioral Response Par. Change	(No - except impact of	alternative FAS takeup	No	No	No
Behavioral Response Str. Change	(No - except impact of	alternative FAS takeup	No	No	No
STRUCTURAL ALTERNATIVES:					
Refundable tax credits	Not done but could	Not done but could	Yes		
Other tax credits	Not done but could	Not done but could	No		
Low income rebates	Not done but could	Not done but could	No	Yes	
Child rebates	Not done but could	Lib 87 child care all	No	Liberal 1990 Proposals	
Family Allowance Supplements	Not done but could	Labor 87 proposal	No		
Actual 1987 Family Package	Not done but could	Impact on Poverty	No		
ARPA Age Pension Proposals 1989	Not done but could	Yes- impact and costs	No		
Wage - Tax Packages	Not done but could	No	No	Labor 1990 proposals	
Child care rebates	Not done but could	Yes	No	Liberal 1990 Proposals	
Family Rebate replacg DSR & SPR	Not done but could	Not done but could	No	AIFS 89 & 90 proposals	
Medicare - Maximum Levy	Not done but could	Not done but could	No		
Consumption taxes	No - cant do	No - cant do	No		
Income test on sole parent rebate	Not done but could	Not done but could	No		
Income Test FA on principal earner	Not done but could	Not done but could	Yes		
Income test Fam All on joint incomes	Not done but could	Not done but could	Yes		
Tax family allowances on joint income	Not done but could	Not done but could	No		
Income test DSR on family income	Not done but could	Not done but could	No		
Cash out DSR in hands of mother	Not done but could	Not done but could	Yes		
Diff threshold for second earner	Not done but could	Not done but could	No		
Lower threshold for FA recipient	Not done but could	Not done but could	No		
Low income rebates by family type	Not done but could	Not done but could	No	Yes	
Non-stand. Low Income Supplements	Not done but could	Not done but could	No		
Extra rent assistance for kids	Not done but could	Yes	No		
Change tax on any payment	Not done but could	Not done but could	No		
New payments	Not done but could	Not done but could	No		
Savings clauses	No - cant do	No - cant do	No		
Earnings credits	No - cant do	No - cant do	No		
Income test exemptions	Not done but could	Not done but could	No		
Separate inctest on RA	Not done but could	Yes	No		
Tax exemption level not thresh	Not done but could	Not done but could	No		
General surcharge/rebate	Not done but could	Not done but could	No		
Over Seventies arrangements	Not done but could	Yes	No		

Income Survey Based Static Models : Output

VARIABLES/FORMATS COVERED	NIEIR Annual Incomes	NIEIR Current Incomes	PCU TAX87	AIFS ACTUALS	SPRC TATLIB
OUTPUT:					
Medium	Paper/files	Paper/files	Paper/Screen	Paper & files	Paper
Format	Tables, statistics etc	Tables, statistics etc	Tables	Tables & lists	Tables
Direct Comparison	If required	If required	Of options	No	No?
USER INTERFACE:					
Menu driven	No	No	No	No	No Choice of macros
Parameter change method	Edit program	Edit program	Edit parm file	Edit progrm	Macro
Parameter change recalculation time	n/a	n/a	30 minutes		
Structural alternatives method	Edit program	Edit program	Edit program	Edit progrm	Change macro
PROGRAMMER INTERFACE:					
Machine	Vax 11/750	Vax 11/750	Amdahl mainframe	DSS IBM	IBM3090
Language/ Software	SAS	SAS	SAS	SAS	SAS
Record Format - data	SAS file	SAS file	SAS	SAS	SAS
Record Format - parameters	In program	In program	In program	Program	Macro code
Memory Management			Not attempted		
Reasons for choosing hardware	Availability	Availability	Available and big	Availability	Available
Reasons for choosing software	Use by non-prgmers and availability	Use by non-prgmers and availability	Data step flexibility and experience	Potential for extensive data manipulation	Familiarity
SENSITIVITY/ ACCURACY					
Test original ABS data:					
-- Gov Cash Benefit Numbers	Yes	Yes	Yes		
-- Tax Statistics	Yes	Yes	Yes	Yes	
-- Labour Force Survey	Yes	Yes	No		
Test Imputations:					
Tested against later income survey	Yes	Yes	No		
Tested against later HES	No	No	No		
Against DSS client numbers	Yes	Yes	Yes	Yes- FA & FAS	Yes
Against DSS expenditure	Yes	Yes	No	Yes- FA & FAS	Yes
Against Taxpayer numbers	Yes	Yes	No	Yes	
Against tax rebate numbers	Yes	Yes	Yes	Yes	
Against tax collected $	Yes	Yes	No	Yes	
Against tax expenditure components	No	No	No	Yes	
Statistical error in data calc	No	No	No		
Statistical error in projections	No	No	No		
Sensitivity to weighting	Yes	Yes	No		
Sensitivity to choice indexes	No	No	No		
Sensitivity to imputation technique	Yes	Yes	No	FA,FAS, AUSTUDY	
Sensitivity to annual vs current data	Yes	Yes	No	DSR for 2nd income	

HES Based and Combined Models: Input Requirements

	EXPENDITURE SURVEY BASE		COMBINED HYPO/MICRO	
	WARREN STATAX	ABS FIS	COPS SPAT/TAXMOD	DSS Planned (a) Policy Effects Model
DATA SOURCE	1984 HES	1984 HES- full data	(Own DB from82 IHS, (86 IDS,84 HES,Hypo	1988-89 HES
MODEL TYPE	Static	Static	Static	Hypothetical, Static
GROUPS: DEMOGRAPHIC				
Head Age	Yes	Yes	Yes	Yes
Spouse Age	Yes	Yes	Yes	Yes
Head Sex	Yes	Yes	Yes	Yes
Spouse sex	Yes	Yes	Yes	Yes
Children Age	Yes	Yes	Yes	Yes
Head Study Status	No	Yes	Yes	Yes
Spouse Study Status	No	Yes	Yes	Yes
Children Study Status	No	Yes	Yes	Actual over 15, Impute under
Head Work Status	Yes	Yes	Yes	Yes
Spouse Work Status	Yes	Yes	Yes	Yes
Children Work Status	Yes	Yes	Yes & Income	Yes & Income if over 15
Income Unit - Nature of Occupancy	Yes- renters not split	Yes	Yes- HH & 'Family'	Yes
Household Person counts	Yes	Yes	Yes	Yes
INCOME DATA:				
SOURCES:				
Current private assessable	Yes	Yes	Yes	Yes
Current private taxable	Yes	Yes	Yes	Yes
Current private by detailed source	Yes	Yes	Yes	Yes
Annual private Assessable	No	No	Yes	Hyp-yes, Mic-impute for stable incr
Annual private taxable	No	No	Yes	Hyp-yes, Mic-impute for stable incr
Annual separate net income	No	No	Imputed	Hyp-yes, Mic-impute for stable incr
Annual private by detailed source	No	No	Yes	Hyp-yes, Mic-impute for stable incr
Last year private taxable	No	No	Yes-for FA,FAS,ProvTax	Yes
Parent Taxable Last Year	No	Not used		If at home
Current GCB- taxable	Yes	Yes	Yes	Yes
Current GCB- Non-taxable	Yes	Yes	Yes	Yes
Annual GCB- taxable	No	No	Yes	Hyp-yes, Mic-for stable incomes
Annual GCB- Non-taxable	No	No	Yes	Hyp-yes, Mic-for stable incomes
Current Earnings	Yes	Yes	Yes	Yes
Annual Earnings	No	No	Yes	Hyp-yes, Mic for stable incomes
Current maintenance	Yes	Yes	Yes	Yes
Annual maintenance	No	No	Yes	Yes
Overseas Pensions	No	No	Not seperately-in other	Hyp-yes , Mic-No
Income Form:				
Direct measures	Yes	Yes	Yes	Yes
Updated Measures	Yes	No	Yes	Yes
Projected measures	Yes	No	Yes	Yes
Hypothetical	Yes	No	Yes	Yes
Income Format:				
Dollars and cents	Yes	Yes		Yes
Single dollars			Yes	Yes
Ranges				Yes
Mean of ranges				No
EXPENDITURE DATA:				
Detailed by commodity	Yes	Yes	From HES Regression	In source -will be summarised
Broad category	If required	Yes	From HES Regression	Yes
Current Indirect Taxation Category	Yes	Yes	Yes-from input-output	No
Future Indirect Taxation Category	Yes	No	Yes	No
Format:				
Dollars and cents	Yes	Yes	Yes	Yes
TIME PERIOD	1984/5 to 1989/90	'1984	1981/2 onwards	Hyp- 1980-1991, Mic-88/89 on
TIME UNIT	fiscal year or time poin	Point in time	Fiscal year	Quarter and fiscal year

Note (a) These specifications for the DSS model reflect current thinking. Plans are subject to both resource and data availablity as well as the effect of priorities on phases of development.

HES Based and Combined Models: Update Requirement

	EXPENDITURE SURVEY BASE		COMBINED HYPO/MICRO	
	WARREN STATAX	ABS FIS	COPS SPAT/TAXMOD	DSS Planned (a) Policy Effects Model
PRIVATE INCOMES UPDATE:		Not applicable		
Wages and Salaries	{23 variables used		{National Accounts	AWE quarterly and distribution
Self-employment	{in total		{Public Finance	NA Unincorp Industry
Interest	{		{	NA other interest received
Dividends	{		{	NA- dividends received
Rent	{		{	CPI- Private rental component
Superannuation	{		{	AWE
Worker's compensation	{		{	AWE
Maintenance and alimony	{		{	Admin data
Income from other source	{		{	CPI
Private Income Projection Assumptions		Not applicable	Historic growth rate	Official
EXPENDITURE DATA	44 CPI components	Not applicable	13 CPI components	CPI components
GOVERNMENT CASH BENEFITS:				
Annual amount	Imputed	Not applicable	Imputed	Hyp-yes , Mic- impute if stable
Weekly amount	Imputed	Not applicable	No	Yes
Overseas pensions- direct deductions	No	no	No	Hyp-yes, Mic-No
Age Pension	Imputed	na-direct measure	Imputed	Impute
Invalid Pension	Imputed	na-direct measure	File Elig, Imputed $	Mic-file elig, imputed $
Widow's Class A	Imputed	na-direct measure	Imputed	Mic-file elig, imputed $
Widow's Class B	Imputed	na-direct measure	Imputed	Mic-file elig, imputed $
Supporting Parent's Benefit	Imputed	na-direct measure	Imputed	Mic-file elig, imputed $
Wifes Pension	Imputed	na-direct measure	Imputed	Mic-file elig, imputed $
'Other' Pension	Imputed	na-direct measure	Imputed	Mic-file elig, imputed $
Unemployment Benefit	Imputed	na-direct measure	Imputed	Mic-file elig, imputed $
Sickness Benefit	Imputed	na-direct measure	Imputed	Mic-file elig, imputed $
Special Benefit	Imputed	na-direct measure	Not seperately-in other	Mic- attempt to impute receipt
Family Allowances	Imputed	na-direct measure	Imputed	Mic- impute elig & $
Family Income Supplement	Imputed	na-direct measure	Imputed	Hyp timeseries only
Family Allowance Supplement	Imputed	na-direct measure	Imputed	Mic-attempt to impute from file
Veterans Affairs Payments	Imputed	na-direct measure	File Elig, Imputed $	Impute
Mixed DSS/DVA	?			Impute
Education Allowances 16-17 yr olds	Imputed	na	Yes	File elig & impute $
Education Allowances 18+ yrs	Imputed	na	Yes	File elig & impute $
Married pension split method	?		?	Detailed
INCOME TAXATION				
Non-taxable GCBs	?	Current value imputed	Imputed	Impute
Maintenance	No?	Current value imputed	Yes-file	Admin index
Deductions	No	Current value imputed	Yes	Constant by income level
Dependent spouse rebate	Yes	Current value imputed	Yes	Impute
Sole Parent Rebate	Yes	Current value imputed	Yes	Impute
Pensioner and beneficiary rebate	Yes	Current value imputed	Yes	Impute
"Other" rebates	No	Current value imputed	No	Hyp-detail Mic-if possible
Separate net income	Yes	Current value imputed	Yes	Impute
Medicare levy	Yes	Current value imputed	Yes	Impute
REWEIGHTING		Original survey weights		
Age by Gender		for households	ABS pop survey	LFS# & population projections
Marital Status	{ 3 LFS variables		LFS	
Labour force status	{ used #		LFS	LFS#
Sole Parents			No	LFS#
Government cash beneficiaries	Yes		No	By Family status,gender,employmt
Taxpayers			No	
Gender	Probably LFS#		Pop stats	
Dependent children				Yes
Method			Growth by age,sex & State then map other variables on	GCB benchmarks and estimate HH pop not on major cash benefit by adjusted LFS proportions

Note (a) These specifications for the DSS model reflect current thinking. Plans are subject to both resource and data availability as well as the effect of priorities on phases of development.

HES Based and Combined Models: Coverage

TAX/BENEFITS COVERED	EXPENDITURE SURVEY BASE WARREN STATAX	ABS FIS	COMBINED HYPO/MICRO COPS SPAT/TAXMOD	DSS Planned (a) Policy Effects Model
DSS PAYMENTS & TESTS:				
Age Pension - under 70	Hd + Sps	Yes	Yes	Yes
Age Pension - 70 & over	Yes	Yes	Yes	Yes
Age Pension- mixed age	No	Yes	Yes	Yes
Wifes Pension- Aged	Yes	Yes	Yes	Yes
Invalid Pension	Yes	Yes	Yes	Yes
Wifes pension- Invalid,SEA,Rehab	Yes	Yes	Yes	Hyp-yes, Mic as Invalid Pension
Carers Pension	No	No	No	Hyp-yes
Sheltered Employment Allowance	No	Not seperately	No	Hyp-yes
Rehabilitation Allowance	No	Not seperately	No	Hyp-yes
Mixed Pension - Benefit	No	Yes	No	Yes
Couple Living Apart - Medical Reasons	No	No	No	Hyp-yes
Sole Parent's Pension	Yes	Yes	Yes	Yes
Widows Pension Class B	Yes	Yes	Yes	Yes
Widowed Persons Allowance	Yes	As Widows	As Widows Class C	Yes
Unemployment Benefit- Couple	Yes	Yes	Yes	Yes
Unemployment Benefit- Single Adult	Yes	Yes	Yes	Yes
Unemployment Benefit- Sing. 18-20	Yes	Yes	Yes	Yes
Job Search Allowance	No	As Junior UB	Yes	Yes
Young homeless Allowance	No	No	No	Hyp- yes , Mic- No
Sickness Benefit	Yes	Yes	Yes	yes
Sickness Benefit- age rel rates	Yes	na	Not yet	Yes
Special Benefit	Yes	No	No	Hyp-yes , Mic impute some categories
Special Benefit Categories	No	No	No	Hyp-if parms different, Mic-some
Family Allowance	Yes	Yes	Yes	Yes
Family Allowance Income Test	Yes	na	Yes	Yes
Family Allowance Supplement	Yes	na	Yes	Yes
Family Income Supplement	Yes	na	Yes	Hyp - historical
Multiple Births Payments	No	No	No	Possibly
Child Disability Allowance	No	Not even HCA	No	Hyp -yes , Mic no
Mobility Allowance	No	na	No	Hyp-yes
Remote Area Allowance	No	na	No	Hyp-yes
Additional Pen/Ben Children-any age	Yes	Not separately	Yes	Yes
Additional Pen/Ben Children-age rel	Yes	na	No	Yes
Mother's /Guardians Allowance	Yes	Not separately	Yes	Yes
Rent Assistance	Yes	Not separately	Yes	Yes
Children's Income Testing	Yes	No	No	Hyp -yes, Mic- dep on data release
Assets Test on Anything	No	No	No	Hyp- possibly
Liquid Assets Tests	No	No	No	Mic- possibly form asset incomes
Earnings Credits	No	No	No	Yes
VETERANS AFFAIRS PAYMENTS:				
Service Pension	Yes	Yes- not type	Yes	Yes
Disability pension- Special	No	Yes- not type	Yes - Average rate	Hyp-yes, Mic-possibly if can identify
Disability pension- Intermediate	No	Yes- not type	Included in DVA amt	Hyp-yes, Mic-possibly if can identify
Disability pension- General	No	Yes- not type	Included in DVA amt	Hyp-yes, Mic-possibly if can identify
Extreme Disablement Allowance	No	na	No	Hyp-yes, Mic-possibly if can identify
War & Defence Widows Pension	Yes	Yes- not type	Yes - Average rate	Hyp-yes, Mic-possibly if can identify
Domestic Allowance	No	Yes- not type	No	Not initially
Orphans Pension	No	Yes- not type	No	Not initially
Attendant Allowance	No	Yes- not type	No	Not initially
Clothing Allowance	No	na	No	Not initially
Section 27 Increased rate> 1-6	No	na	No	Not initially
Section 27 Increased rate> 7-15	No	na	No	Not initially
Recreational Transport Allowance	No	na	No	Not initially
Vehicle Assistance Allowance	No	Not separately	No	Not initially
Veteran's Children Education Scheme	No	Not separately	No	Mic- if can identify
Guardian's Allowance	Yes	Not separately	No	Yes
Additional Pension for Children	Yes	Not separately	No	Yes
Rent Assistance	Yes	Not separately	No	Yes
Remote Area Allowance	No	na	No	Hyp-yes
MIXED DVA/DSS PAYMENT	No	Yes	No	Hyp-yes, Mic to extent identifiable

Note (a) These specifications for the DSS model reflect current thinking. Plans are subject to both resource and data availability as well as the effect of priorities on phases of development.

HES Based and Combined Models: Coverage (page 2 of 3)

TAX/BENEFITS COVERED	EXPENDITURE SURVEY BASE WARREN STATAX	ABS FIS	COMBINED HYPO/MICRO COPS SPAT/TAXMOD	DSS Planned (a) Policy Effects Model
DEPARTMENT OF EMPLOYMENT, EDUCATION, & TRAINING				
AUSTUDY	Yes	As 'Student Assistance	Yes	Yes
ABSTUDY	No	As 'Student Assistance	No	No
Assistance For Isolated Children	No	As 'Student Assistance	No	No
Formal Training Allowance	No	No	No	Hyp-yes, Mic-probably cant identify
Fares Assistance Scheme	No	No	No	Hyp-yes
JOBSTART (subsidy)	No	Precursor imputed	No	Possibly in late phase
CRAFT living away from home allow'c	No	Precursor imputed	No	Hyp-yes
CRAFT (subsidy)	No	Precursor imputed	No	Possibly in late phase
Higher Education Contribution Scheme				
- Upfront payment	No	na	No	Hyp-yes
Parental Income Tests	No	No	Yes	Yes
Independence Tests	No	No	No	Hyp-yes
Assets Tests	No	No	No	Hyp-possibly
DEPARTMENT OF COMMUNITY SERVICES AND HEALTH				
Disadvantaged Persons Health Schm	No	Not separately	Yes	Yes - eventually
Pensioner Health Benefits	No	Not separately	Yes	Yes - eventually
Pensioner Pharmaceutical Benefits	No	Not separately	Yes	Yes - eventually
Health Care Card benefits	No	Not separately	Yes	Yes - eventually
Health Benefits Card	Yes	Not separately	Yes	Yes - eventually
General Pharmaceutical Benefits	No	Not separately	Yes	Yes - eventually
Nursing Home Benefit	No	To households!!!!!!!!!!!	No	Yes - eventually
Hearing Services	No	Not separately	No	No
First Home Owners Scheme	No	Yes	As general subsidy	Yes
Emergency Relief	No	To GCB recipients	No	No
Child Care Fee Relief	No	To GCB recipients!!!!!	No	YEs
STATE HOUSING AUTHORITIES				
Public Rent Rebates	No	Not separately	No	Yes
Mortgage & Rent relief	No	Not separately	No	Possibly
Low Interest & Special Mortgages	No	Not separately	No	Possibly
Home equity conversions	No	Not separately	No	Hyp-possibly
Local & Community Housing	No	Not separately	No	No
OTHER AUTHORITIES				
Telephone concessions	No	Not separately	No	Yes - eventually
Transport concessions	No	Not separately	No	Yes - eventually
Rate concessions	No	Not separately	No	Yes - eventually
Electricity & Gas rebates	No	Not separately	No	Yes - eventually
Health Services- free or reduced cost	No	Not separately	No	Not in initial phases
Student allowances	No	Not separately	No	Not in initial phases
Other education concessions	No	Not separately	No	Not in initial phases
Motor registration concessions	No	Not separately	No	Yes - eventually

Note (a) These specifications for the DSS model reflect current thinking. Plans are subject to both resource and data availability as well as the effect of priorities on phases of development.

TAX/BENEFITS COVERED	EXPENDITURE SURVEY BASE WARREN STATAX	ABS FIS	COMBINED HYPO/MICRO COPS SPAT/TAXMOD	DSS Planned (a) Policy Effects Model
INCOME TAXATION				
PAYE tax	Yes	Imputed	Yes	Yes
Provisional Tax	No	No	Yes**********	Yes
Prescribed Payments Scheme	No	na	No	No
Capital Gains Tax	No	na	No	No
Partnerships	No	No	No	No
Trusts	No	No	No	No
Medicare Levy	Yes	Imputed	No	Yes
Retirement Income Taxation	No	No	No	Yes
Superannuation Fund Taxation	No	na	No	
Non-retirement termination payments	No	No	No	Hyp-possibly
Leave Bonus	No	No	No	
Dividend Imputation	No	na	No	Yes
Income Averaging schemes	No	No	No	No
Business Income Deductions	No	No	No	No
Other deductions	No	Yes	Yes	Yes -allowance by income level
Primary producer Av'g & deductions	No	No	No	No
Taxation of Minors	Yes*****************	?	No	Possibly
Part-year taxation	No	No	No	No
Non-reporting factor adjustment	No	No	Yes***************	
CHILD SUPPORT	Yes *************	na	No	Yes
HIGHER EDUCATION CONTRIBUTIONS SCHEME- arrears	No	na	No	Possibly in later phase
Dependant Spouse Rebate	Yes	Yes	Yes	Yes
Other Dependant rebates-Hskpr etc	No	No	No	Hyp-no
Sole Parent Rebate	Yes	Yes	Yes	Yes
Pensioner Rebate	Yes	Yes	Yes	Yes
Beneficiary Rebate	Yes	Yes	Yes	Yes
Zone rebates	No	Yes*****(ABS has area)	No	Hyp-yes, Mic-no
Medical Expenses rebate	Yes*****************	No?	No	Possibly
Tax Expenditures	Yes*****************	No	No?	Probably limited to those above
INDIRECT TAXATION				
Wholesale Sales Tax	Yes	Yes	Yes-Regression	No
Payroll tax	Yes		Via input/output tables	No
Taxes on Immovable Property	Yes		Via input/output tables	No
Estate, Inheritance & Gift Duties	No	No	No	No
Financial & Capital transaction taxes	Yes	Not separately	Via input/output tables	No
Excises on petroleum products	Yes	Not separately	Via input/output tables	No
Excises on beer and potable spirits	Yes	Not separately	Via input/output tables	No
Excises on tobacco products	Yes	Not separately	Via input/output tables	No
Other excises	Yes	Not separately	Via input/output tables	No
Customs duties	Yes	Not separately	Via input/output tables	No
Taxes on gambling	Yes	Not separately	Via input/output tables	No
Taxes on insurance	Yes	Not separately	Via input/output tables	No
Motor Vehicle taxes	Yes	Not separately	Via input/output tables	No
Franchise taxes	Yes	Not separately	Via input/output tables	No
Departure tax	Yes	Not separately	Via input/output tables	No
Broadcasting licences	Yes	Not separately	Via input/output tables	No
Fees & Fines	Yes	Not separately	Via input/output tables	No
COVERAGE UNITS				
Household	Yes	Yes	Yes	Yes
Family	Yes		Yes **************	No
Income Unit	Yes		Can if wish to	Yes
IU Head	Yes		As 'family head'	Yes
IU Spouse	Yes		As 'family spouse'	Yes
Children	Yes*****************		15+	Yes

Note (a) These specifications for the DSS model reflect current thinking. Plans are subject to both resource and data availability as well as the effect of priorities on phases of development.

HES Based and Combined Models: Output

VARIABLES/FORMATS COVERED	EXPENDITURE SURVEY BASE WARREN STATAX	ABS FIS	COMBINED HYPO/MICRO COPS SPAT/TAXMOD	DSS Planned (a) Policy Effects Model
ANALYTIC VARIABLES:				
Gross income	Yes	Yes	Yes	Yes
Gross income - Business deductions	No	No		No
Gross income - Other tax deductions	No	No	Yes	Yes
Gross income accruing not received	No	No	No	Hyp-perhaps
DSS income as assessed	Yes	Yes	Most components	Yes
Gross income after child care	No	No	No	Yes
Gross income after housing costs	Yes	Yes	No	Yes
Separate net income	Yes	Yes	Yes	Yes
Total rebates	Yes	Yes	Yes	Yes
Gross medicare levy	Yes		Yes	Yes
Net medicare levy	Yes		Yes	Yes
Gross tax	Yes	Yes	Yes	Yes
Net tax	Yes	Yes	Yes	Yes
Rebates unused	Yes	No	In output datbase	Yes
Disposable income (ie after tax)	Yes	Yes	Yes	Yes
Disposable income after housing	Yes	No	In principle	Yes
Disposable income after child care	No	No	No	Yes
Disp. Inc. after hsg & child care	No	No	No	Yes
Equivalent disposable incomes:	No	Yes		
- Simplified Henderson	No		No	Yes
- Detailed Henderson before hsq	No		No	Yes
- Detailed Henderson after hsq	No		No	Yes
-ABS	No	Yes- Consumption Unit	No	Yes
-OECD	No		No	Yes
-Whiteford Geometric Mean	No		No	
- Swedish	No	Yes	No	
Poverty Line on AWE	No	No	No	
Poverty Line on HDI	No	No	No	Yes
Point Marginal Rates	No	No	Yes- for graphs	Point and interval
Effective Marginal Tax Rates:				
- After Inc Tax & DSS (1)	Yes	No	Yes	Yes
- After IT&SS & Child Care (2)	No	No	No	Yes
- After IT&SS&CC & Hsg (3)	No	No	No	Yes
- After above (n) & Health (4)	No	No	No	No
- After above (n) & Indirect tax (5)	1 + Indirect	No	After 1	No
Average Tax Rates-which of above	1 & 5		1 & 5	(1) & (2) & (3)
Net Tax Liability- FA as credit	Yes		Yes	Yes
Net Tax/Benefit Liability	Yes- No Indirect Ben		Yes	Yes-those in model
Expenditure taxation	Yes******	Yes	Yes	No
Total expenditure	Yes	Yes	Yes	Yes- adjusted savings ratios
Apparent savings	Yes-uses HES data	No	Impute or impose	Measured and adjusted
Total tax incidence	Yes	Yes	Yes	No
Total Direct & Indirect Benefits	No	Yes***************	Yes	Only those in model
Quantile Types available	Deciles,quintiles	Deciles,quintiles	Deciles,quintiles	Deciles, percentiles
Distributional Statistics Available	Gini,Atkinson Inequal	Gini,Coef. Concentratio	None	Not yet determined

Note (a) These specifications for the DSS model reflect current thinking. Plans are subject to both resource and data availability as well as th effect of priorities on phases of development.

HES Based and Combined Models: Output

VARIABLES/FORMATS COVERED	EXPENDITURE SURVEY BASE: WARREN STATAX	EXPENDITURE SURVEY BASE: ABS FIS	COMBINED HYPO/MICRO: COPS SPAT/TAXMOD	COMBINED HYPO/MICRO: DSS Planned (a) Policy Effects Model
TIME SERIES STATISTICS:		Not Applicable	Not directly	
Gross Income	Yes			Yes
Disposable incomes	Yes			Yes
Gov Cash Benefit Incomes	Yes			Yes
Takeup and cost of State concessions	No			No
Housing affordability projections	No			No
Real Incomes - CPI				Yes
Real Incomes - CPI components				
Real Incomes - AWT E- All Males				Yes
Real Inc. - AWT E- All M. Nov Svy				Yes & also possibly combined
Real Inc. - HDI PCap				Yes
Real Inc. - HI PCap				Possibly
DSS Income Index				Yes
Disposable Income Index				
Nominal/ Real Conversion				Yes
Change of base year				Yes
IMPACT ANALYSIS:				
Costings of parameter change	Yes	No***************	Yes	Mic-yes
Costings of structural change	Yes	No***************	Yes	Mic-yes
Winners/Losers Parameter Change	Yes & losses/gains	No***************	Yes & losses/gains	Yes- and losses/gains
Winners/Losers Structural Change	Yes & losses/gains	No***************	Yes & losses/gains	Yes
Behavioral Response Par. Change	Yes****************	No	No	No
Behavioral Response Str. Change	Yes****************	No	No	No
STRUCTURAL ALTERNATIVES:		NONE		
Refundable tax credits	Yes		Yes	Possibly
Other tax credits	Yes		Targetted threshold	
Low income rebates	Yes		Yes	Yes
Child rebates	Yes		Yes	Yes
Family Allowance Supplements			Yes	Yes
Actual 1987 Family Package			Could be done	Yes
ARPA Age Pension Proposals 1989				
Wage - Tax Packages			Could be done	Yes
Child care rebates	Yes- specific context		Yes	Yes
Family Rebate replacg DSR & SPR			Family Tax System	Yes
Medicare - Maximum Levy	Yes		Could be done	Yes
Consumption taxes	Yes		Yes	No
Income test on sole parent rebate	Yes		Could be done	Possibly
Income Test FA on principal earner	Yes		Could be done	
Income test Fam All on joint incomes	Yes		Could be done	Possibly
Tax family allowances on joint income	Yes		Could be done	
Income test DSR on family income	Yes		Could be done	Possibly
Cash out DSR in hands of mother	Yes		Could be done	Possibly
Diff threshold for second earner	Yes		Could be done	
Lower threshold for FA recipient	Yes		Could be done	
Low income rebates by family type	Yes		Yes	Possibly
Non-stand. Low Income Supplements	Yes		Yes	
Extra rent assistance for kids	Yes			Yes
Change tax on any payment	Yes			Yes
New payments	Yes			Yes
Savings clauses	No			Possibly
Earnings credits	Yes			Yes
Income test exemptions	Yes			Yes
Separate inctest on RA	Yes			Hyp - Historically
Tax exemption level not thresh	Yes		Yes	Possibly
General surcharge/rebate	Yes		Yes	Possibly
Over Seventies arrangements	Yes			Yes
Abolition of rebates &/or family payments			Yes	yes
Guaranteed Minimum Income	Yes			No
Family Unit Taxation	Yes		Optional	No
Broad Based Consumption Tax	Yes		Yes	No
General Sales Tax	Yes		Yes	No

Note (a) These specifications for the DSS model reflect current thinking. Plans are subject to both resource and data availability as well as th effect of priorities on phases of development.

HES Based and Combined Models: Output

VARIABLES/FORMATS COVERED	EXPENDITURE SURVEY BASE: WARREN STATAX	ABS FIS	COMBINED HYPO/MICRO: COPS SPAT/TAXMOD	DSS Planned (a) Policy Effects Model
OUTPUT:				
Medium	Paper, Files	Paper, Files	Paper,screen ,file	Paper,screen ,file
Format	Tables,Trees,Graphs	Tables, Graphs	Tables,graphs,listings	Tables,graphs,listings
Direct Comparison	Yes	Not applicable	YES	YES
USER INTERFACE:				
Menu driven	No-select via parm fil	No	YES***********	Yes
Parameter change method	Edit parm file	Program	Pull down menu	Edit parameter file for each Q
Parameter change recalculation time			Interactive	
Structural alternatives method	Select Parm or prgm	na	Pull down menu	Some inbuilt
PROGRAMMER INTERFACE:				
Machine	PC	FACOM M382 or 780	IBM PC	AMDAHL or PC
Language/ Software	FORTRAN77	SAS	C	One of SAS/C/Modula2
Record Format - data		SAS	Binary	
Record Format - parameters		?	Binary	
Memory Management			Dynamic	
Reasons for choosing hardware		Available	Interactive	Departmental strategy
Reasons for choosing software	Familiarity	Ease of use	Make interactive and friendly	User-friendliness & maintainability
SENSITIVITY/ ACCURACY				
Test original ABS data:				
-- Gov Cash Benefit Numbers		Yes	Yes- more being done	Will be necessary
-- Tax Statistics		Yes	Yes- more being done	Will be necessary
-- Labour Force Survey		?	Yes- more being done	Will be necessary
Test Imputations:				
Tested against later income survey			Yes	
Tested against later HES				
Against DSS client numbers			Yes	Essential
Against DSS expenditure			Yes	Essential
Against Taxpayer numbers	Yes	Yes	Yes	Necessary
Against tax rebate numbers	Yes	Yes	Yes	Necessary
Against tax collected $	Yes	Yes	Yes	Necessary
Against tax expenditure components	Yes		Yes	Necessary
Statistical error in data calc			No	
Statistical error in projections		na	No	
Sensitivity to weighting			Planned	Will be necessary
Sensitivity to choice indexes			Planned	Maybe eventually
Sensitivity to imputation technique			Planned	Maybe eventually
Sensitivity to annual vs current data			Planned	Will be necessary

Note (a) These specifications for the DSS model reflect current thinking. Plans are subject to both resource and data availability as well as th effect of priorities on phases of development.

Utility Function and Micro-Macro Models: Input Requirements

	UTILITY FUNCTION MODELS		MICRO-MACRO MODELS	
	RATSSS	RATSSS	NIEIR	IAESR
	Fiscal Incidence	Behavioural	HES/IMP	IHS/ORANI
DATA SOURCE	81/82 & 85/86 Inc Svys	81/82 & 85/86 Inc Svys	1984 HES+ Nat Accts	1981-2 IHS+Nat Acct
MODEL TYPE	Static	Static	Micro to Macro	Macro to micro
GROUPS: DEMOGRAPHIC				The model looks at
Head Age	Yes	Yes- married couples only	Yes	the effects of the
Spouse Age	Yes	Yes	Yes	change to a broad
Head Sex	Yes	Yes	Yes	based consumption
Spouse sex	Yes	Yes	Yes	tax and the lowering
Children Age	Yes	Yes		of personal income
Head Study Status	Yes	Yes		tax. The changes in
Spouse Study Status	Yes	Yes		the macro-model
Children Study Status				parameters are
Head Work Status	Yes	Yes	Yes	decomposed in the
Spouse Work Status	Yes	Yes		income survey data
Children Work Status			Yes	using gender, income
Income Unit - Nature of Occupancy	Yes- renters not split 86	Yes- renters not split 86	Yes	source, labour force
Household Person counts			Yes	participation, and
INCOME DATA:				occupation.
SOURCES:				
Current private assessable			Yes	
Current private taxable			Yes	
Current private by detailed source			Yes	
Annual private Assessable	Yes	Yes		
Annual private taxable	Yes	Yes		
Annual separate net income	Yes	Yes		
Annual private by detailed source	Yes	Yes		Yes
Last year private taxable				
Parent Taxable Last Year				
Current GCB- taxable			Yes	
Current GCB- Non-taxable			Yes	
Annual GCB- taxable	Yes	Yes		
Annual GCB- Non-taxable	Probably	probably		
Current Earnings			Yes	
Annual Earnings	Yes	Yes		Yes
Current maintenance			Yes	
Annual maintenance	Probably	probably		
Overseas Pensions	No	No		
Income Form:				
Direct measures	Yes	Yes		Yes
Updated Measures	Yes	Yes	Yes	
Projected measures	Yes	Yes	Forwards& Backwards	
Hypothetical	No	No		
Income Format:				
Dollars and cents	Yes	Yes	Yes	yes
Single dollars				
Ranges				
Mean of ranges				
EXPENDITURE DATA:				
Detailed by commodity	No	No	Yes	In ORANI-NAGA
Broad category	No	No		macro models
Current Indirect Taxation Category	Constant rate	Constant rate		
Future Indirect Taxation Category	Constant rate	Constant rate		
Format:				
Dollars and cents	Yes	Yes	Yes	
Dollar Ranges				
Mean of Ranges				
TIME PERIOD	1981/2 to 1989/90	1981/2 to 1989/90	1967/68 to 2000	1981-82
TIME UNIT	Tax year	tax year	Annual for aggregates	year

Utility Function and Micro-Macro Models: Update Requirements

	UTILITY FUNCTION MODELS		MICRO-MACRO MODELS	
	RATSSS	RATSSS	NIEIR	IAESR
	Fiscal Incidence	Behavioural	HES/IMP	IHS/ORANI
PRIVATE INCOMES UPDATE:				
Wages and Salaries	AWE	AWE	Wkly Earngs (August)	From ORANI-NAGA
Self-employment	AWE	AWE	NA unincorp* Industry	From ORANI-NAGA
Interest	National Accounts	National Accounts	NA other interest rcvd	From ORANI-NAGA
Dividends	National Accounts	National Accounts	NA- Dividends rcvd	From ORANI-NAGA
Rent	National Accounts	National Accounts	CPI - Private rent com	From ORANI-NAGA
Superannuation	AWE	AWE	Wkly Earngs (August)	
Worker's compensation	AWE	AWE	Wkly Earngs (August)	
Maintenance and alimony	AWE	AWE	Assumed Constant	
Income from other source	AWE	AWE	NA- Houseshld Income	
Private Income Projection Assumptions	Not applicable	Not applicable	IMP model	
EXPENDITURE DATA	Not applicable	Not applicable	*Demogaphic variables from historical simulatn	
GOVERNMENT CASH BENEFITS:				
Annual amount	DSS payment rates	DSS payment rates	No	Yes- Indexed by CPI
Weekly amount			Yes	
Overseas pensions- direct deductions	No	no	No	
Age Pension	No	No	Impute elig + $	No indication that disaggregated
Invalid Pension	No	No	File elig + impute $	
Widow's Class A	No	No	Impute elig + $	
Widow's Class B	No	No	Impute elig + $	
Supporting Parent's Benefit	No	No	Impute elig + $	
Wifes Pension	No	No	As Age Pen couple	
'Other' Pension	No	No	File elig + impute $	
Unemployment Benefit	No	No	Impute elig + $	
Sickness Benefit	No	No	File elig + impute $	
Special Benefit	No	No	Excluded	
Family Allowances	Yes	Yes	File elig + impute $	
Family Income Supplement	Yes	Yes	Imp takeup adj elig & $	
Family Allowance Supplement	Yes	Yes	Imp takeup adj elig & $	
Veterans Affairs Payments	No	No	File Elig+pension index	
Mixed DSS/DVA	No	No	File Elig+pension index	
Education Allowances 16-17 yr olds	No	No	File elig + paymt index	
Education Allowances 18+ yrs	No	No	File elig + paymt index	
Married pension split method	na	na	Half of IU payment	
INCOME TAXATION				
Non-taxable GCBs	Yes	Yes	Removed	The Draft White Paper tax scales were deflate 1981/2 and adjusted to obtain preshock revenue neutrality.
Maintenance			Removed	
Deductions			TI* 0.03	
Dependent spouse rebate	Yes	Yes	Imputed	
Sole Parent Rebate	Yes	Yes	Imputed	
Pensioner and beneficiary rebate	Yes	Yes	Imputed	
"Other" rebates			TI*0.005	
Separate net income	Yes	Yes	TI-FA-FIS	
Medicare levy	Yes	Yes	Imputed	
REWEIGHTING	Not applicable	Not applicable		Not applicable
Age by Gender			Exogenous estimates produced from NIEIR demographic model esp % married females, dwelling stock,age, and % children	
Marital Status				
Labour force status				
Sole Parents				
Government cash beneficiaries				
Taxpayers				
Gender				
Method			See above	

Utility Function and Micro-Macro Models: Coverage (page 1 of 3)

TAX/BENEFITS COVERED	UTILITY FUNCTION MODELS RATSSS Fiscal Incidence	RATSSS Behavioural	MICRO-MACRO MODELS NIEIR HES/IMP	IAESR IHS/ORANI
DSS PAYMENTS & TESTS:				
Age Pension - under 70	No	No	Yes	Govenment cash
Age Pension - 70 & over	No	No	Yes	benefits are indexed
Age Pension- mixed age	No	No	No	by the consumer
Wifes Pension- Aged	No	No	Treat as AP couple	price index.
Invalid Pension	No	No	Yes	The decomposition
Wifes pension- Invalid,SEA,Rehab	No	No	No	focuses more on
Carers Pension	No	No	No	those employed.
Sheltered Employment Allowance	No	No	No	
Rehabilitation Allowance	No	No	No	
Mixed Pension - Benefit	No	No	No	
Couple Living Apart - Medical Reason:	No	No	No	
Sole Parent's Pension	No	No	Yes	
Widows Pension Class B	No	No	Yes	
Widowed Persons Allowance	No	No	No	
Unemployment Benefit- Couple	No	No	Yes	
Unemployment Benefit- Single Adult	No	No	Yes	
Unemployment Benefit- Sing. 18-20	No	No	Yes	
Job Search Allowance	No	No	?	
Young homeless Allowance	No	No	No	
Sickness Benefit	No	No	Yes	
Sickness Benefit- age rel rates	No	No	No	
Special Benefit	No	No	No	
Special Benefit Categories	No	No	No	
Family Allowance	Yes	Yes	Yes	
Family Allowance Income Test	Yes	Yes	Yes	
Family Allowance Supplement	Yes	Yes	Yes	
Family Income Supplement	Yes	Yes	Yes	
Multiple Births Payments	No	No	No	
Child Disability Allowance	No	No	No	
Mobility Allowance	No	No	No	
Remote Area Allowance	No	No	No	
Additional Pen/Ben Children-any age	No	No	Yes	
Additional Pen/Ben Children-age rel	No	No	Yes?	
Mother's /Guardians Allowance	No	No	Yes	
Rent Assistance	No	No	?	
Children's Income Testing	No	No	No	
Assets Test on Anything	No	No	No	
Liquid Assets Tests	No	No	No	
Earnings Credits	No	No	No	
VETERANS AFFAIRS PAYMENTS:				
Service Pension	No	No	Yes	
Disability pension- Special	No	No	Yes	
Disability pension- Intermediate	No	No	Yes	
Disability pension- General	No	No	Yes	
Extreme Disablement Allowance	No	No	No	
War & Defence Widows Pension	No	No	Yes	
Domestic Allowance	No	No	No	
Orphans Pension	No	No	No	
Attendant Allowance	No	No	No	
Clothing Allowance	No	No	No	
Section 27 Increased rate> 1-6	No	No	No	
Section 27 Increased rate> 7-15	No	No	No	
Recreational Transport Allowance	No	No	No	
Vehicle Assistance Allowance	No	No	No	
Veteran's Children Education Scheme	No	No	If showed as Edu Pay	
Guardian's Allowance	No	No	Yes - not sep	
Additional Pension for Children	No	No	Yes - not sep	
Rent Assistance	No	No	?	
Remote Area Allowance	No	No	No	
MIXED DVA/DSS PAYMENT	No	No	No	

Utility Function and Micro-Macro Models: Coverage (page 2 of 3)

TAX/BENEFITS COVERED	UTILITY FUNCTION MODELS RATSSS Fiscal Incidence	RATSSS Behavioural	MICRO-MACRO MODELS NIEIR HES/IMP	IAESR IHS/ORANI
DEPARTMENT OF EMPLOYMENT, EDUCATION, & TRAINING				
AUSTUDY	No	No	Yes	
ABSTUDY	No	No	No	
Assistance For Isolated Children	No	No	No	
Formal Training Allowance	No	No	No	
Fares Assistance Scheme	No	No	No	
JOBSTART (subsidy)	No	No	No	
CRAFT living away from home allow'c	No	No	No	
CRAFT (subsidy)	No	No	No	
Higher Education Contribution Scheme				
- Upfront payment	No	No	No	
Parental Income Tests	No	No	No	
Independence Tests	No	No	No	
Assets Tests	No	No	No	
DEPARTMENT OF COMMUNITY SERVICES AND HEALTH				
Disadvantaged Persons Health Schm	No	No	No	
Pensioner Health Benefits	No	No	No	
Pensioner Pharmaceutical Benefits	No	No	No	
Health Care Card benefits	No	No	No	
Health Benefits Card	No	No	No	
General Pharmaceutical Benefits	No	No	No	
Nursing Home Benefit	No	No	No	
Hearing Services	No	No	No	
First Home Owners Scheme	No	No	No	
Emergency Relief	No	No	No	
Child Care Fee Relief	No	No	No	
STATE HOUSING AUTHORITIES				
Public Rent Rebates	No	No	No	
Mortgage & Rent relief	No	No	No	
Low Interest & Special Mortgages	No	No	No	
Home equity conversions	No	No	No	
Local & Community Housing	No	No	No	
OTHER AUTHORITIES				
Telephone concessions	No	No	No	
Transport concessions	No	No	No	
Rate concessions	No	No	No	
Electricity & Gas rebates	No	No	No	
Health Services- free or reduced cost	No	No	No	
Student allowances	No	No	No	
Other education concessions	No	No	No	
Motor registration concessions	No	No	No	

Utility Function and Micro-Macro Models: Coverage

(page 3 of 3)

TAX/BENEFITS COVERED	UTILITY FUNCTION MODELS RATSSS Fiscal Incidence	UTILITY FUNCTION MODELS RATSSS Behavioural	MICRO-MACRO MODELS NIEIR HES/IMP	MICRO-MACRO MODELS IAESR IHS/ORANI
INCOME TAXATION				
PAYE tax	Yes	Yes	Yes	Yes
Provisional Tax			No	
Prescribed Payments Scheme	No	No	No	
Capital Gains Tax	No	No	No	
Partnerships	No	No	No	
Trusts	No	No	No	
Medicare Levy	Yes	Yes	Yes	
Retirement Income Taxation	No	No	No	
Superannuation Fund Taxation	No	No	No	
Non-retirement termination payments	No	No	No	
Leave Bonus	No	No	No	
Dividend Imputation	No	No	No	
Income Averaging schemes	No	No	No	
Business Income Deductions	No	No	No	
Other deductions			Yes	
Primary producer Av'g & deductions	No	No	No	
Taxation of Minors	No	No	No	
Part-year taxation	No	No	No	
Non-reporting factor adjustment	No	No	No	
CHILD SUPPORT	No	No	No	
HIGHER EDUCATION CONTRIBUTIONS SCHEME- arrears	No	No	No	
Dependant Spouse Rebate	Yes	Yes	Yes	
Other Dependant rebates-Hskpr etc	No	No	No	
Sole Parent Rebate	Yes	Yes	Yes	
Pensioner Rebate	No	No	Yes	
Beneficiary Rebate	No	No	Yes	
Zone rebates	No	No	No	
Medical Expenses rebate	No	No	No	
Tax Expenditures	No	No	No	
INDIRECT TAXATION				
Wholesale Sales Tax	No	No	No	
Payroll tax	No	No	No	
Taxes on Immovable Property	No	No	No	
Estate, Inheritance & Gift Duties	No	No	No	
Financial & Capital transaction taxes	No	No	No	
Excises on petroleum products	No	No	No	
Excises on beer and potable spirits	No	No	No	
Excises on tobacco products	No	No	No	
Other excises	No	No	No	
Customs duties	No	No	No	
Taxes on gambling	No	No	No	
Taxes on Insurance	No	No	No	
Motor Vehicle taxes	No	No	No	
Franchise taxes	No	No	No	
Departure tax	No	No	No	
Broadcasting licences	No	No	No	
Fees & Fines	No	No	No	
Constant rate indirect tax	Yes	Yes		
COVERAGE UNITS				INDIVIDUALS
Household			Yes	
Family			No	
Income Unit	Yes	Married couples,Hd wkg	Yes	
IU Head	Yes	Yes	Yes	
IU Spouse	Yes	Yes	Yes	
Children	No	No	No	

Utility Function and Micro-Macro Models: Output (page 1 of 3)

VARIABLES/FORMATS COVERED	UTILITY FUNCTION MODELS RATSSS Fiscal Incidence	RATSSS Behavioural	MICRO-MACRO MODELS NIEIR HES/IMP	IAESR IHS/ORANI
ANALYTIC VARIABLES:				
Gross Income	Yes	Yes		Yes
Gross Income - Business deductions	No	No		
Gross income - Other tax deductions	No	No		
Gross income accruing not received	No	No		
DSS income as assessed	No	No		
Gross income after child care	No	No		
Gross income after housing costs	No	No		
Separate net income	Yes	Yes		
Total rebates	Yes	Yes		
Gross medicare levy	Yes			
Net medicare levy	Yes			
Gross tax	Yes	Yes		
Net tax	Yes	Yes		
Rebates unused	?	?		
Disposable income (ie after tax)	Yes	Yes	YES	Yes
Disposable income after housing etc	No	No		
WELFARE ORDERING:				
Welfare Ordering - pre-tax income	Yes	Yes		
Welfare Ordering - disposable income	Yes	Yes		
Money metric utility	Yes	Yes		
Utility index	Yes	Yes		
Equivalent income at given utility level	Yes	Yes		
WELFARE CHANGE:				
Net cash gain	Yes	Yes		
Change in tax paid	Yes	Yes		
Money metric equivalent welfare chang	Yes	Yes		
Utility index change	Yes	Yes		
Average gains	Deciles	Deciles		
Percentage benefitting :				
- for each welfare ordering	Deciles	Deciles		
Marginal tax rates	Yes	Yes		
Effective Marginal Tax Rates:				
-After income tax (1)	Yes	Yes		
- After Inc Tax & DSS FA & FAS (2	Yes	Yes		
- After (2) and other income tests	No	No		
Average Tax Rates-which of above	(1) & (2)	(1) & (2)		
Efficiency gain measures	Yes	Yes		
Social gain measures	Yes	Yes		
Expenditure taxation	No	No		
Total expenditure	No	No	BY COMMODITY	
Apparent savings	No	No		
Total tax incidence	No	No		
Total Direct & Indirect Benefits	No	No		
Quantile Types available	Deciles	Deciles		Decile
Distributional Statistics Available	Atkinson Inequality	Atkinson Inequality		Shorrock's Index

Utility Function and Micro-Macro Models: Output (page 2 of 3)

VARIABLES/FORMATS COVERED	UTILITY FUNCTION MODELS RATSSS Fiscal Incidence	RATSSS Behavioural	MICRO-MACRO MODELS NIEIR HES/IMP	IAESR IHS/ORANI
TIME SERIES STATISTICS:				Not applicable
Gross Income	Yes	Yes		
Disposable incomes	Yes	Yes	YES	
Gov Cash Benefit incomes	No	No		
Takeup and cost of State concessions	No	No		
Housing affordability projections	No	No		
Real incomes - CPI				
Real incomes - CPI components				
Real incomes - AWT E- All Males				
Real Inc. - AWT E- All M. Nov Svy				
Real Inc. - HDI PCap				
Real Inc. - HI PCap				
DSS income index				
Disposable income index				
Nominal/ Real Conversion				
Change of base year				
IMPACT ANALYSIS:				
Costings of parameter change				
Costings of structural change			IN POPULATION	
Winners/Losers Parameter Change	Yes & losses/gains	Yes & losses/gains- +/- behavioural response		Yes
Winners/Losers Structural Change	Yes & losses/gains	Yes & losses/gains- +/- behavioural response		Yes
Behavioral Response Par. Change	Yes****************	Yes****************	No	
Behavioral Response Str. Change	Yes****************	Yes****************	No	
STRUCTURAL ALTERNATIVES:				
Refundable tax credits	Yes	Yes		
Other tax credits	Yes	Yes		
Low income rebates	Yes	Yes		
Child rebates	Yes	Yes		
Family Allowance Supplements	Yes	Yes		
Actual 1987 Family Package	Yes	Yes		
ARPA Age Pension Proposals 1989	No	No		
Wage - Tax Packages	Yes	Yes		
Child care rebates	Yes	Yes		
Family Rebate replacg DSR & SPR	Yes	Yes		
Medicare - Maximum Levy				
Consumption taxes	Constant rate only	Constant rate only		YES
Income test on sole parent rebate	Yes	Yes		
Income Test FA on principal earner	Yes	Yes		
Income test Fam All on joint incomes	Yes	Yes		
Tax family allowances on joint income	Yes	Yes		
Income test DSR on family income	Yes	Yes		
Cash out DSR in hands of mother	Yes	Yes		
Diff threshold for second earner	Yes	Yes		
Lower threshold for FA recipient	Yes	Yes		
Low income rebates by family type	Yes	Yes		
Change deduction levels	Yes	Yes		
Tax exemption level not thresh	Yes	Yes		
General surcharge/rebate				
Abolition of rebates &/or family payment	Yes	Yes		
Guaranteed Minimum Income	Yes	Yes		
Family Unit Taxation	Yes	Yes		
Broad Based Consumption Tax	No	No		YES
General Sales Tax	No	No		

Utility Function and Micro-Macro Models: Output (page 3 of 3)

VARIABLES/FORMATS COVERED	UTILITY FUNCTION MODELS RATSSS Fiscal Incidence	RATSSS Behavioural	MICRO-MACRO MODELS NIEIR HES/IMP	IAESR IHS/ORANI
OUTPUT:				
Medium	Disk, Screen ,Paper	Disk, Screen ,Paper	Paper	Paper
Format	Tables, listings	Tables, listings	Tables	Tables
Direct Comparison	Yes	Yes-incl +/- behv change	Yes	
USER INTERFACE:				
Menu driven	Yes	Yes	No	
Parameter change method	Edit parameter file	Edit parameter file		
Parameter change recalculation time	Interactive	Interactive		
Structural alternatives method	Change subroutine	change subroutine		
PROGRAMMER INTERFACE:				
Machine	IBM PC	Being modified for IBM PC		
Language/ Software	FORTRAN	FORTRAN		
Record Format - data				
Record Format - parameters				
Memory Management				
Reasons for choosing hardware				
Reasons for choosing software	Familiarity	Familiarity		
SENSITIVITY/ ACCURACY				
Test original ABS data:				
-- Gov Cash Benefit Numbers				
-- Tax Statistics				
-- Labour Force Survey				
Test Imputations:				
Tested against later income survey				
Tested against later HES				
Against DSS client numbers				
Against DSS expenditure				
Against Taxpayer numbers				
Against tax rebate numbers				
Against tax collected $				
Against tax expenditure components				
Statistical error in data calc				
Statistical error in projections				
Sensitivity to weighting				
Sensitivity to choice indexes				
Sensitivity to imputation technique				
Sensitivity to annual vs current data				

APPENDIX B

BIBLIOGRAPHY ON AUSTRALIAN MICROSIMULATION MODELS

HYPOTHETICAL MODELS

DSS Timeseries

Moore, Jim and Whiteford, Peter (1986), *Trends in the Disposable Incomes of Australian Families 1964-65 to 1985–86*, Background/Discussion Paper No. 11, Social Security Review, Department of Social Security.

AIFS Hypothetical (various versions)

Brownlee, Helen (1985), 'Poverty traps', *Australian Tax Forum*, Vol 2, No. 2, Winter.

Burbidge, Andrew and Maas, Frank (1984), 'Throwing out the baby... the need to assess unintended outcomes of tax transfer options' in *Key Papers Part 2 XXth CFR Seminar on Social Change and Family Policies*, Institute of Family Studies, Melbourne, August.

Maas, Frank, Brownlee, Helen and King, Anthony (1987a), *Assessment of the Impact of Tax Reforms Proposed by the Liberal Party of Australia in June 1987*, AFIT Bulletin No.3, Australian Institute of Family Studies, Melbourne.

Maas, Frank, Brownlee, Helen and King, Anthony (1987b), *Assessment of the Impact of Changes to the Tax-Transfer System Proposed by the Australian Labour Party in June 1987*, AFIT Bulletin No.4, Australian Institute of Family Studies, Melbourne.

Australian Institute of Family Studies (1989a), *Families and Tax in 1989*, AFIT Bulletin No. 5, Australian Institute of Family Studies.

Australian Institute of Family Studies (1989b), *Families and the Tax Package*, AFIT Bulletin No. 6, Australian Institute of Family Studies.

Australian Institute of Family Studies (1990a), *The Coalition Parties' Family Tax Package*, AFIT Bulletin No. 7, Australian Institute of Family Studies.

Australian Institute of Family Studies (1990b), *Taxes, Families and the Labor Party, 1990*, AFIT Bulletin No. 8, Australian Institute of Family Studies.

EPAC Lotus

Economic Planning Advisory Council (1988), *Income Support Policies, Taxation and Incentives*, Council Paper 35, Australian Government Publishing Service, Canberra.

INCOME SURVEY BASED STATIC MODELS

NIEIR Annual Incomes

King, Anthony (1986), 'An estimate of the extent of poverty in Australia in 1985–86 using microanalytic simulation methods', pp.127-38 in Council of Welfare Ministers *Income Support Seminar, Melbourne, 8-9 December*.

King, Anthony (1987a), 'Analysing the distributional consequences of policy: the uses of microanalytic simulation methods', *National Economic Review*, 6, pp.7-28, February.

Manning, Ian, King, Anthony and Yates, Judith (1988), *Housing Futures*, a report to the Victorian State Advisory Committee for the International Year for Shelter for the Homeless.

King, Anthony, Foster, Will and Manning, Ian (1990), *Microsimulation at NIEIR: Development and Applications*, this volume.

NIEIR Current Incomes

King, Anthony(1987b), *Short-term Income Distribution Forecasting: Notes on Derivation of Australian Income Distribution Series from July 1982 to July 1987*, unpublished paper, NIEIR, Melbourne.

King, Anthony (1987c), *The Distribution of Current Disposable Incomes: an Estimation Using Techniques of Microanalytic Simulation*, NIEIR Working Paper No. 1, National Institute of Economic and Industry Research, November 1987.

King, Anthony (1988), *Assessment of the Impact of the Family Package on the Incidence of Poverty: Technical Notes*, unpublished paper, Australian Institute of Family Studies, Melbourne.

Brownlee, Helen and King, Anthony (1989), 'The estimated impact of the family package on child poverty', in Edgar, D., Keane, D. and McDonald, P. (eds) *Child Poverty*, Allen and Unwin, Sydney.

Maas, Frank, Brownlee, Helen and King, Anthony (1987a), *Assessment of the Impact of Tax Reforms Proposed by the Liberal Party of Australia in June 1987*, AFIT Bulletin No.3, Australian Institute of Family Studies, Melbourne.

Maas, Frank, Brownlee, Helen and King, Anthony (1987b), *Assessment of the Impact of Changes to the Tax-Transfer System Proposed by the Australian Labour Party in June 1987*, AFIT Bulletin No.4, Australian Institute of Family Studies, Melbourne.

King, Anthony and Manning, Ian (1988), *Victorian State Concessions: Their Incidence and Projected Value*, a report to the Department of Management and Budget, Victoria.

King, Anthony and Manning, Ian (1989), *The Incidence of State Concessions in New South Wales*, a report to the Cabinet Office, NSW.

King, Anthony (1989), *Costing the ARPA Proposals for the Australian Aged*, a report to the Australian Retired Persons Association.

PCU TAX87

Results from the full model were never published. The reweighting and private income updating procedures were used for Dixon, Daryl, Foster, Chris and Gallagher, Phil (1985), *Tax Credits and Reform of the Tax and Social Security Systems*, Research Study No.2, Australian Tax Research Foundation, Sydney.

AIFS Actuals

Australian Institute of Family Studies (1989), *Families and Tax in 1989*, AFIT Bulletin No. 5, Australian Institute of Family Studies.

Australian Institute of Family Studies (1990a), *The Coalition Parties' Family Tax Package*, AFIT Bulletin No. 7, Australian Institute of Family Studies.

Australian Institute of Family Studies (1990b), *Taxes, Families and the Labor Party, 1990*, AFIT Bulletin No. 8, Australian Institute of Family Studies.

SPRC TATLIB

Bradbury, B., Doyle, J., and Whiteford, P. (1990), *Trends in the Disposable Incomes of Australian Families, 1982–83 to 1989–90*, Social Policy Research Centre, Discussion Paper No. 16, University of New South Wales, Kensington.

Bradbury, Bruce (1990), 'Modelling the Impact of Labour Market Changes on the Distribution of Family Incomes', this volume.

EXPENDITURE SURVEY BASED MODELS

Warren STATAX

Warren, Neil, (1987), *The Distributional Impact of a Change in the Tax Mix in Australia*, Research Study No. 6, Australian Tax Research Foundation, Sydney.

Warren, Neil (1988), 'Flattening the Income Tax Rate Scale Through Changes in the Tax Mix', *Australian Tax Forum*, 4(2), pp.181-217.

Warren, Neil (1989), 'Changes in Australian tax incidence between 1975–76 and 1984–85', in J.G. Head (ed.), *Australian Tax Reform in Retrospect and Prospect*, Australian Tax Research Foundation, Conference Series No. 8, pp. 445–478.

Warren, Neil (1989), 'The spatial incidence of selected N.S.W. taxes in 1985–86', in *Review of the State Tax System Volume 2: Commissioned Studies*, NSW Tax Task Force, 1989, pp. 63–159.

Warren, Neil (1990 forthcoming), 'Indirect taxes, tax mix and tax equity', in J.G. Head (ed) *Flattening the Tax Rate Scale: Alternative Scenarios and Methodologies*, Australian Tax Research Foundation, Conference Series.

ABS FIS

Australian Bureau of Statistics (1987), *1984 Household Expenditure Survey, Australia: The Effects of Government Benefits and Taxes on Household Income*, Australian Bureau of Statistics Catalogue No. 6537.0.

Castles, Ian (1987a), 'The Effects of Government Benefits and Taxes on Household Incomes: Estimates for Australia and Other Countries' in *Redistributing the Welfare State: Estimating the Effects of Government Benefits and Taxes on Household Income*, SWRC Reports and Proceedings No. 67, Social Welfare Research Centre, University of New South Wales, Kensington.

Castles, Ian (1987b), *Money Income Distribution and Redistribution in Australia, Sweden and the United States 1984*, Paper presented to the ANZAAS Townsville Congress, Australian Bureau of Statistics, Canberra.

Anderson, Michael (1989), *A Preliminary Study of the Distribution of Income, Taxes and Benefits of Farm Households*, Paper presented at the Economic Society of Australia Annual Conference, July 1989.

COMBINED HYPOTHETICAL/MICROSIMULATION MODELS

COPS TAXMOD

Bascand, Geoffrey and Trengrove, Chris (1987), *Analysis of Tax Reform Options*, Centre of Policy Studies, Monash University, Melbourne.

UTILITY FUNCTION MODEL BASED TAX AND BEHAVIOURAL RESPONSE STUDIES

Apps, Patricia and Savage, Elizabeth (1987), *Welfare Rankings: Utility Consistency and the Unit of Analysis*, mimeograph.

Apps, Patricia (1987a), *Tax and Social Security Reform: An Analysis of Equity and Disincentive Effects*, Occasional Paper No. 2, Australian Tax Research Foundation, Sydney.

Apps, Patricia (1987b), *A Comparitive Analysis of Income Tax and Transfer Options*, Centre for Economic Policy Research, Discussion Paper No. 180, Australian National University.

Apps, Patricia (1987c), *Tax-Transfer Options: A Critique of Joint Income and Flat Rate Proposals*, Centre for Economic Policy Research, Discussion Paper No. 183, Australian National University.

Apps, Patricia (1988a), *Modelling Household Labour Supply and the Welfare Affects of Tax Reforms*, Working Papers in Economics and Econometrics No. 175, Department of Economics, Australian National University.

Apps, Patricia (1988), *Family Policy and Tax-Transfer Options*, Centre for Economic Policy Research, Discussion Paper No. 195, Australian National University.

Apps, Patricia (1989), 'Welfare options under less progressive tax rates: an analysis of distributional effects for working families', *Australian Economic Review*, 4th Quarter.

Jones, Glenn (1990 forthcoming), 'Welfare effects of recent Australian income tax reforms', in J.G. Head (ed.) *Flattening the Tax Rate Scale*, Australian Tax Research Foundation, Sydney.

Savage, Elizabeth (1990 forthcoming), 'Simulating tax reforms: the lessons of the last decade', in J.G. Head (ed.) *Flattening the Tax Rate Scale*, Australian Tax Research Foundation, Sydney.

MICRO-MACRO MODELS

NIEIR HES/IMP

Perkins, J. (1989), *Patterns of Household Expenditure*, Paper presented to the Econometrics Conference, University of New England, Armidale NSW, July 13–15 1989, National Institute of Economic and Industry Research, Melbourne.

IAESR IHS/ORANI

Meagher, Geoff and Agrawal, Nisha (1986), 'Taxation reform and income distribution in Australia', *The Australian Economic Review*, 3rd Quarter.

DYNAMIC MODELS

Harding Model

Harding, Ann (1990), *Dynamic Microsimulation Models: Problems and Prospects*, Paper presented at the British Sociological Association Annual Conference, University of Surrey, 2-5 April 1990.

NIEIR Model

Foster, Will (1990), *National Institute of Economic and Industry Research Dynamic Microsimulation Package*, unpublished paper.

King, Anthony, Foster, Will and Manning, Ian (1990), *Microsimulation at NIEIR: Development and Applications*, this volume.

DISCUSSION

Peter Saunders
Social Policy Research Centre

Together, these two papers serve an extremely useful role in documenting overseas and Australian experience with tax-benefit models and microsimulation techniques. We owe a good deal to both authors for the very valuable 'state of the art' surveys with which they have provided us. Rather than deal with the two papers separately, I will try and concentrate on some of the more significant issues raised in both papers.

Otto Hellwig's paper reminds us that the development of Australian microsimulation methods—only now in its infancy—is occurring sometime after that in many other countries, including the US, UK, Germany, Hungary, the Netherlands and Canada. Phil Gallagher's paper indicates that while the Australians may have entered the race a few laps behind the rest of the pack, we have quite a large and varied field ourselves, even though many of us are by no means fully 'up and running' at this stage.

It is, however, perhaps worth noting at the outset that the application of tax-benefit models and microsimulation methods in Australia does, in fact, have quite a long history. Anyone who estimates the tax paid by a person with a given income level and personal circumstances, or calculates their social security entitlements, has to make *some* assumptions about income composition (to obtain taxable income), the availability of tax deductions and rebates, the extent of income and assets for social security means test purposes, and so on. These assumptions in fact constitute a tax-benefit model, albeit a highly simplified one. Furthermore, application of these techniques in order to estimate how today's policy changes will affect people over the course of the next year involves the use of a microsimulation model, albeit again a highly simplified one. The developments described in the two papers just presented thus build on earlier Australian work by people like David Collins, Jim Moore and Peter Whiteford, Fred Gruen, and myself, all of whom have used simplified tax-benefit models and microsimulation techniques to explore the implications of current and past trends in tax-transfer policies for the living standards of Australians. Such models can, of course, be applied more widely to investigate such issues as the redistributive impact of actual and proposed policy reforms and their cost. More sophisticated answers to such questions can, in principle at least, be obtained from models which also incorporate behavioural responses into their structure. Increasingly, research institutes around Australia–represented at this Workshop–are developing these models and using them for a range of policy and research purposes of this sort.

Otto Hellwig begins his paper by noting that the development of microsimulation 'was always application driven', and ends with a prediction that 'within a few years microsimulation will become the standard tool for policy analysis'. Phil Gallagher's paper confirms the former proposition and, by implication, the latter also. This, it seems to me, is both an exciting and somewhat frightening prospect. It does, however, serve as a useful lead into the comments I wish to make, since the strong link between tax-benefit models and microsimulation methods and policy evaluation is likely to have an important influence in shaping our future research agenda. That *may* not be a bad thing, but its implications do need to be given some consideration.

Many of these issues revolve around data availability, content, cost and timeliness, and I will deal with some of these first. Phil Gallagher is right to point out the concern that the Australian Bureau of Statistics (ABS) might discontinue its release of unit record tapes. The enormous value of the unit record tapes already released for researchers and policy analysts—and thus eventually for the community generally—needs to be acknowledged. We could of course, continue to microsimulate into the future from the data we already have, but that is hardly the preferred choice of any of us. Continued and timely release of unit record data is thus *essential*: there are simply no two ways about it. An interesting question to arise in this context is whether a discontinuation of unit record data release would limit the development and role of microsimulation models, or actually add to their importance.

Assuming that unit record data do continue to be released (I am an economist, remember!) there remain significant issues relating to *data quality* and *model coverage*. On the *model coverage* question, I was struck in Phil Gallagher's paper by the degree to which detail on social security and other government program benefits was requested in his survey. None of the existing models he surveys consider these in that degree of detail, in large part because the data are not available. But there is an important issue here about what *type* of extra detail one would wish to see collected in future. If the models are solely or primarily for policy purposes, then details relevant to current (or proposed) policies would be appropriate. In contrast, those of us in the academic research community would be more interested, I suspect, in greater detail on those socioeconomic characteristics that are more relevant to our broader research and hypothesis testing requirements. There are clearly some areas of overlap, but I suspect that the differences outnumber the similarities, as between those working within and outside government policy agencies.

On *data quality*, my limited exposure to these models leads me to question the reliability of some of the available data, as it relates, for example, to receipt of social security payments. How much of the survey data should we use as the basis for modelling, and how much should be discarded entirely and modelled? How much difference does it make, and what do these differences tell us? Questions of, for example, the *take-up* of social security, and the extent of *tax avoidance* and *evasion* are relevant here. There is a related question about the actual samples on which the models are based. All models use only a subset of the data on the ABS tapes, but on what basis are the exclusions decided and again, what difference do these make to the results?

This question leads on to my last point, which relates to the question of *validation*. This is, of course, essential to the advance of scientific knowledge, yet we have paid relatively little attention to it. I would like to see more attention devoted to this by, for example, asking the modellers to produce the same simulations and for these to be independently compared and analysed. Sensitivity analysis *within* models can then be accompanied by sensitivity analysis *across* models. I would be interested to know, for example, how the sensitivities due to variation in economic parameters (e.g. labour supply and other relevant elasticities) compare with those reflecting different ways in which exclusions are specified when constructing the basic sample (e.g. the treatment of the self employed, those whose family circumstances change, and the length of the time period of analysis).

Otto Hellwig and Phil Gallagher have done an excellent job in cataloguing the current state of play of tax-benefit models and microsimulation methods in Australia. The issues mentioned here have hopefully raised questions relating to where we might go from here in order to better exploit the full potential of such developments.

DISCUSSION

Neil Warren
School of Economics, University of New South Wales

The comments which I wish to make can be divided into four areas: data, models, issues to address in microsimulation models and finally the development of Australian microsimulation models.

1. DATA

The discussion in the two papers highlighted the four basic requirements of microsimulations studies:

a) Data Structure. The data necessary for microsimulations are unit record data detailing the experience of groups in the household sector.

b) Nature of data. Data on the income, expenditure and the stock and accumulation of wealth of the household sector.

c) Period covered by the data. The data may come in two basic forms—cross sectional data from a survey of households at a specific point in time or longitudinal (panel) data which reports the lifetime experience of individuals in the population.

d) Behavioural Parameters. If we are interested in examining the impact of government policy reforms in the longer term context, then it is essential that microsimulation models incorporate the behavioural response of individuals to policy changes. These models must in turn reflect what is occurring at the macroeconomic level, confirmed by macroeconomic forecasting models. It is therefore important that microsimulation models be seen as a complement to macroeconomic models. The difficulty for microsimulation models however, is that the specification of the behavioural response parameters is at best in early stages of study.

The information requirements of microsimulation studies are clearly considerable if they are to be undertaken at their most comprehensive level of detail. The fact is that data which meets all the above requirements is not available in Australia. While unit record information exists for household income and expenditure, there is some concern over the reliability of this data and the apparent extent of dissaving by a majority of households. This is compounded by the lack of any comprehensive data on the financial assets of households which is required to gauge the households' scope for eroding their financial asset stock.

In the future, some thought will have to be given to collecting financial asset data in the cross-sectional surveys (such as the Household Expenditure Surveys and the Income and Housing Surveys). Thought must also be given to collecting longitudinal (or panel) data to identify the changing behaviour of individuals over time, thus facilitating studies into life-cycle issues or, when combined with long term macroeconomic model predictions, the impact on households of changes in the economy over a period longer than one year.

The one clear conclusion from this section is that the data available to those undertaking microsimulation studies has much scope for expansion and improvement.

2. MODELS

Three types of microsimulation models have been specified in the two papers: calculators, static simulation models and dynamic simulation models. The Hellwig paper canvasses these different types of models as developed overseas, concluding that Australia has examples of the former two but no dynamic simulation models.

Gallagher identifies some 21 different microsimulation models in Australia, all developed in the last five years. These models vary widely in sophistication, the primary determinant of this being how the models are used and the data sources on which they draw. The Hellwig paper indicates that while Australian researchers have developed static microsimulation models, they have as yet not taken a major step towards the development of dynamic simulation models as has been the case overseas.

There are several reasons for this including the data requirements for such models; the cost in funding such a program, which if overseas experience is anything to go by, is significant; and staffing such a program of research given the limited experience of Australian researchers in this field.

The future research plans indicated by Gallagher and Hellwig to be undertaken by DSS and NIEIR do indicate that staff and resources will be allocated to the future development of microsimulation models.

3. ISSUES TO BE ADDRESSED IN MICROSIMULATION MODELS

The advantage of microsimulation models is that they offer significant information to policy makers about how their proposed policies impact on different groups within the community. However, to date, such models have only been used to provide a 'snapshot' of the impact of reforms on different groups and not their impact in a broader context such as over a lifetime or at different stages in a person's life-cycle.

However, as indicated in previous sections, the major constraint on the potential for microsimulation models to be realized is data availability, whether it be unit record household data or data on the behavioural response of households.

4. DEVELOPMENT OF AUSTRALIAN MICROSIMULATION MODELS

There can be little doubt that there are significant benefits to policy makers from having access to microsimulation models, especially when integrated into medium term macroeconomic models. While quite significant developments have been made in formulating static microsimulation models, as was noted above, we have some way to go before developing dynamic microsimulation models.

In concluding, it can be said that while the paper by Gallagher indicates the progress that has been made in developing microsimulation models in Australia, the Hellwig paper shows just how far Australian researchers have to go before reaching similar stages of development to those of other researchers overseas. The primary factor that is ultimately restraining researchers from progressing further appears to be the lack of suitably comprehensive data. Of special interest is longitudinal data on not only the income and expenditure of individuals, but data on their financial assets. The Australian government must seriously consider increasing the funding to the Australian Bureau of Statistics or to special research groups to enable them to undertake such surveys in the future.

MICROSIMULATION AT NIEIR: DEVELOPMENT AND APPLICATIONS

Anthony King, Will Foster and Ian Manning
National Institute of Economic and Industry Research, Melbourne

1. MICROSIMULATION AND NIEIR

The National Institute of Economic and Industry Research (NIEIR) has been involved in applications of microanalytic simulation (microsimulation) techniques since the release by the ABS of unit record data from the *1981–82 Income and Housing Survey* (1981–82 IHS) in 1985. Since that time, work has proceeded at NIEIR on the development of microsimulation models and their use in a range of practical research applications. The Institute is continuing to expand its activities in this area of research and analysis.

The first part of this paper provides a brief statement of the characteristics of microsimulation, then describes the interest of NIEIR in these techniques, and presents an outline of the experience with microsimulation at NIEIR.

1.1 The Nature of Microsimulation

This section includes only a statement of the key characteristics of microsimulation. A general discussion of the nature and potential of microsimulation applications, and a review of the literature, has been provided in King (1987a). Hellwig (1990a) presents a comprehensive review of the overseas experience with microsimulation and a discussion of 'dynamic' microsimulation models in particular is provided by Harding (1990).

1.1.1 Key Features

Microsimulation is a powerful tool for distributional analyses in the field of socio-economic research and policy development. As the name suggests, the two key features of microsimulation techniques are:

1. a microdata base, and
2. a capacity for simulation.

The microdatabase typically contains the results of a large sample survey which describes the population in detailed terms of incomes, expenditures, and various other socio-economic characteristics. Importantly, the data needs to be in the form of unit records; that is, the data is available in a disaggregated form in which the survey variables are attached to the individual units within the sample. Such unit record data from major Australian population surveys of relevant matters have only become available in the past 5 years or so. This fact alone explains the relatively short history of microsimulation applications in Australia compared to the 20-30 years experience in North America and Europe.

The simulation capacity of the technique refers to the construction of a modelling framework by which the microdatabase is manipulated. This framework is designed to incorporate those factors deemed important for the analysis and typically covers detail in at least the areas of demographics, the labour market, private incomes (especially wage and salary incomes), social security incomes and income taxation. Other considerations, such as education, housing or consumption taxation, are also included depending on the particular requirements of the analysis.

Microsimulation can be applied to different types of microeconomic units, for example: firms, farms, households, families, income units or individuals. Here, the concern is with applications involving individuals or groups of individuals.

1.1.2 Key Strengths

Microsimulation has considerable advantages over alternative analytical techniques in many areas of research, with a fundamental strength which stems from its close approximation to the reality of distributions (especially compared to that afforded by alternative analytical techniques). In particular, microsimulation:

1. allows the analysis of distributional impacts at a fine degree of detail and, thereby, can reflect diversity within the population which may be lost through analysis based either on the average circumstances for members of groups within the population or on hypothetical units such as 'typical' families;
2. allows the simultaneous consideration of changes occurring in a number of factors of distributional consequence, unlike the case with more partial analyses which are restricted to consideration of changes in just one or a few factors with the assumption that all other factors remain constant (in reality, the impact of changes in one area is frequently conditioned by changes elsewhere); and,
3. enhances, through the range and detail of attributes included in the database, the ability to model complex socioeconomic processes and institutional arrangements.

1.1.3 The Uses of Microsimulation

Essentially, microsimulation allows detailed assessment and analysis of the distributional impacts stemming from changed conditions. A common application of such models is to assess the impact of changes in the tax-transfer system, though the range of applications is as broad as the above description of the modelling framework suggests. The range of potential areas of application is limited only by the contents of the base data and of the modelling framework.

The types of simulation can vary widely in their approach. While there is endless scope for variation with regard to complexity or the range of factors which are taken into account, there are three important areas of distinction:

1. A first major distinction can be made between those simulations which do and do not seek to explicitly model change over time.
2. Among those approaches which do model change over time, a second major distinction can then be made according to the way in which the passage of time is modelled.
3. A third major distinction concerns the extent to which the full effects, rather than just the first-round effects, of a change are simulated.

The various approaches can be illustrated with reference to the alternative ways to answer a question such as: What would be the distributional impact of doubling the value of unemployment benefits? Suppose the most recent suitable data base for answering this question refers to 1986. The alternative microsimulation approaches to answering the question are outlined as follows:

- The most basic type of microsimulation analysis would simply model the receipt of increased unemployment benefits using the original 1986 database. This would then give an estimate of the first-round distributional impact if the increase had taken place in 1986; a useful first-order estimate, but one which does not consider the effects on the overall impact of either changed circumstances since 1986 or second-round effects of the change. This type of approach is most usually found with tax-benefit models.
- A more sophisticated approach will seek to incorporate in the analysis consideration of the effect on the estimate of changed circumstances since 1986. For example, the level and pattern of unemployment may be very different now to what it was in 1986 and this will clearly condition the estimated impact of the increase in unemployment benefits. Under this approach, the microsimulation model will adjust the database to reflect the changed environment over time, and will then yield an estimate of the first-round distributional impact if the increase took place now.

  In most microsimulation analyses, this explicit consideration of time is a central element. Apart from allowing analyses to be undertaken with reference to current conditions, rather than an out of date database, this property can obviously be extended to allow the projection or forecast of distributions. As noted above, an important distinction exists in the way microsimulation models handle change over time and this leads to two classes of model: 'static' microsimulation models and 'dynamic' microsimulation models. The differences between these two approaches are considered in Section 1.1.5.

- Further elaboration will relate to the extent that other than first-round effects are taken into account. Such effects are of two main types: behavioural responses and macroeconomic implications. In this example of an increase in unemployment benefits, the behavioural response question concerns the impact of the change on work incentives and thus on patterns of labour force participation. The macroeconomic second-round effects (sometimes referred to as third-round effects) would include the distributional ramifications of indirect effects of the initial change in unemployment benefits such as the impacts on government spending, the labour market or household expenditure patterns.

The above example of the alternative types of microsimulation approach indicates the range of uses of the technique. Across a range of subject areas, microsimulation analysis can provide a detailed assessment, albeit with varying degrees of sophistication, in answer to a question of the following form:

- What is the distributional impact of a given change, or changes, at a specific point in time?

This general question can, in turn, be specified to cover:

1. sensitivity analyses,
2. distributional trend analyses,
3. or a combination of both.

1.1.4 The Method of Microsimulation

The centrality of the time element in microsimulation is stressed by the use of the term 'ageing' in the modelling terminology. 'Ageing' refers to the modelling processes whereby the base distribution (the microdatabase) is altered to reflect conditions at a different time. Typically, a distinction is made between 'demographic ageing' and 'economic ageing'.

Demographic ageing refers to the processes which are used to adjust the numbers of different types of unit in the database. This would cover, for instance, changes in the age structure or labour market structure of the population. Economic ageing refers to the processes which are used to alter the economic attributes of units in the database and, typically, would include methods for adjustment of private incomes and a tax-benefit model. The demographic and economic ageing components of the model may be distinct or may involve a substantial degree of overlap and interrelation.

Most processes in microsimulation can be handled either indirectly through reference to external data sources, or through direct modelling of the processes. For example, change in population size could be handled either through reference to external data on population size or by modelling the relevant processes (fertility, mortality and migration). Some aspects, such as tax-transfer components can be handled by direct incorporation in the model of the various institutional rules which determine entitlements and liabilities.

1.1.5 Static and Dynamic Microsimulation

There are two broad types of microsimulation model which are distinguished by their very different approaches to the demographic ageing component of the model. These are termed 'static' and 'dynamic' microsimulation models.

With a 'static' microsimulation model, demographic ageing is accomplished by adjusting the weights which are attached to units in the sample in order to reflect the changed prevalence of particular types of unit in the population. This reweighting is usually undertaken with reference to aggregate statistics on population characteristics. For example, to simulate a doubling of the number of married women who are aged 35-39 years and employed part-time, the weights for all such individuals in the sample would be doubled.

In a 'dynamic' model, on the other hand, ageing is achieved through explicit modelling of demographic and socio-economic processes at the level of the individual unit in the sample. To reflect the probabilistic, rather than deterministic, nature of behavioural processes, a stochastic approach is usually taken in dynamic ageing processes. This is often referred to as 'Monte Carlo' simulation.

While the above difference provides the key distinction between static and dynamic microsimulation models, the latter tend to also include a far greater degree of realism (and complexity) in other aspects of the model. For example, a dynamic model may treat wages in a stochastic manner conditional on a number of attributes. This compares with the usual approach in static microsimulation where wage changes tend to be treated in a deterministic manner 'across the board' with little disaggregation.

There is scope for a static microsimulation model to use more sophisticated approaches to the modelling of matters such as wages (but it would still fall short of the degree of sophistication possible with a dynamic model). The fundamental distinction between the two types of model remains the difference in procedure for demographic ageing. This key difference leads to substantial difference in the capabilities of the two types of model, including the points that:

1. a dynamic microsimulation is far more able to simulate structural change in the population, and
2. whereas a static microsimulation generates new cross-sectional population samples, a dynamic microsimulation has the capacity to generate a longitudinal sample of the population.

There are other areas of advantage of dynamic over static microsimulation such as the capability of dynamic microsimulation to handle the issues of accumulation and longer-term second-round effects. The relative merits of the two approaches are considered further in Section 4.

1.1.6 The Constraints of Data and Computing

Two important practical considerations in microsimulation analyses concern data availability and computing capacity. The issue of data availability refers not only to the existence of a suitable unit record microdatabase but also to the data which is required for both the construction and operation of the modelling framework. The concern with computing capacity refers to both storage capacity and the speed of operations.

The constraints imposed on microsimulation by the extent of data availability and computing capacity are both far more severe for dynamic microsimulation than for static microsimulation.

1.2 The Interest of NIEIR

The National Institute of Economic and Industry Research (NIEIR) was established in Melbourne in 1984 as a research foundation with the aim of carrying out research on matters concerning economic and social policy.

The Institute is an independent organisation funded almost entirely by the users of its services (the exception has been some small government research grants). As such, the Institute's research agenda can be seen as largely determined by the interests of the Institute's clients. On the other hand, the clients and the research questions which the Institute attracts are, in turn, influenced by the Institute's approach to research and particular capabilities.

Unlike a pure consulting organisation, NIEIR devotes considerable effort to the development of research tools. The Institute is probably best known on account of its sophisticated econometric time-series models of the national and State economies. These models support the economic forecasting services of the Institute and much of the economic policy analysis. However, the Institute also has strengths in the area of social policy analysis and conducts considerable work in this area, frequently combining analyses from the economic and social policy perspectives.

The interest of NIEIR in microsimulation techniques stems from three characteristics of the Institute's approach to research:

1. an interest in the broad range of public policy matters,
2. a concern with the distributional consequences of policy (whether they be policies with explicit or with implicit distributional elements), and
3. a belief that aggregate economic models should be founded on sound microeconomic analysis.

The relevance of the first two of these characteristics to an interest in microsimulation is self-explanatory. The third, however, probably warrants some elaboration. Macroeconomic models tend to be constructed on the basis of observed relationships between economic aggregates. This approach falls down, however, when the units within the aggregates exhibit a variation of behaviour and aggregation results in serious micro-information loss. Recognition of such variation has led to the construction of the NIEIR macroeconomic models in a disaggregated fashion in particular with regard to the corporate and public enterprise sectors. The modelling attempts to represent the economic behaviour of large single firms (e.g. Telecom) or groups of firms with the aggregate outcome then being calculated as the sum of the outcomes for the constituent firms. This type of approach is thus founded more on microeconomic theory and modelling business decision-making than on macroeconomic theory. There is an argument for a similar disaggregation in the case of the household sector where household aggregates can depend very much on distributional effects among households.

1.3 NIEIR Experience With Microsimulation: An Overview

From its commencement in 1985, the work on microsimulation at NIEIR has been concerned with the development of both static and dynamic microsimulation models of the Australian population.

The relatively straightforward developmental work required for the static model allowed that model to progress quickly to an operational level. It was first used in a practical research application in 1985 and has since been used by NIEIR in a number of studies including the following areas of analysis: taxation, social security, poverty incidence, housing affordability, expenditure patterns, and State concessions.

The static microsimulation model was initially developed to run with base data from the 1981–82 IHS. It has since been adapted for application on the basis of data from the *1984 Household Expenditure Survey* (1984 HES) and the *1986 Income Distribution Survey* (1986 IDS).

Since its initial specification, the static microsimulation model has become progressively more elaborate, including the development of two quite different versions: one for operation with annual income data and the other with weekly income data.

Meanwhile, substantial preliminary work has been undertaken at NIEIR on development of a dynamic microsimulation model of the Australian population. The model is now operational, in terms of being run successfully for testing purposes, but requires further work on model and parameter specifications to bring it into the realm of practical applications.

The remainder of this paper describes the work at NIEIR on microsimulation in more detail. The next two sections cover the two versions of the static microsimulation model: the annual income version in Section 2 and the weekly income version in Section 3. The dynamic microsimulation model is described in Section 4 and initial work undertaken on macro-micro linkage in Section 5. Some lessons from the NIEIR experience with microsimulation are set out in Section 6. The final section describes elements of the NIEIR program of future work on microsimulation.

2. STATIC MICROSIMULATION OF ANNUAL INCOMES

2.1 The Static Model for Annual Incomes

The first microsimulation work undertaken by NIEIR was concerned with the simulation of annual income distributions on the basis of the 1981–82 Income and Housing Survey. This was initially applied to two research questions: a comparison of the options for tax reform prepared for the 1985 Tax Summit, and a comparison of the incidence of poverty in 1981–82 and 1985–86. The other example at NIEIR of a static microsimulation of annual incomes has been its application, in this case on the basis of 1986 IDS data, to the generation of projections of housing affordability.

The first characteristic of these simulations is their basis on annual income data, rather than the alternative of current (weekly) income data. This choice between using annual or weekly income data is one which frequently arises in designing a microsimulation model, at least in Australia where the unit record data from the two most recent ABS income surveys has been available in both annual and weekly terms. The choice is not straightforward with one form unambiguously superior to the other and, instead, depends on a number of considerations including relevance to the purpose of the particular simulation exercise and ease of modelling. The choice will frequently involve a trade-off between these two considerations.

The NIEIR static microsimulation model of annual incomes includes the following fairly standard stages:

1. Demographic ageing

   (a) Age and sex
   (b) Labour force status

2. Economic ageing

   (a) Private incomes
   (b) Social security incomes
   (c) Income taxation

Demographic ageing is accomplished by reweighting the individual records within the sample with reference to external data. This reweighting is undertaken in two stages. Firstly, the sample is reweighted to reflect changes in the size and distribution of the population with respect to age and sex. Secondly, within each age/sex group, adjustment is made to reflect changes in labour force status including the distinction between full-time work, part-time work, unemployment and not in the labour force. The use of an annual income data base provides the opportunity to model changes in labour force durations though, to date, these have only been explicitly taken into account in the case of durations of unemployment.

Having reweighted the database, economic ageing is undertaken firstly through the application of multipliers (inflators or deflators) with reference to three broad classes of income: wages and salaries, social security incomes, and other incomes. Wages and salary incomes are adjusted according to average earnings statistics, social security incomes according to official rates of payment, and other incomes according to relevant components of the National Accounts household income table. This procedure has been elaborated with imputation techniques where new social security payments are involved. Finally, income tax liabilities are imputed.

2.2 Applications

2.2.1 1985 Tax Summit Options

The comparison of the distributional impacts of the three tax reform options presented in the Federal Government's Draft White Paper on tax reform was part of a major study commissioned by the Australian Council of Trade Unions (Brain, Fung, King and Perkins, 1985). A description of the microsimulation component of the analysis was also included in King (1987a).

The microsimulation covered the income tax and social security (compensation) provisions of the three options. The work entailed, firstly, the derivation of an up-to-date income distribution through updating the 1981–82 IHS annual income data to 1984–85 and imputing income tax payments. Secondly, the income tax and social security components of the three options were simulated. Account was also taken of the 'base-broadening' measures included in the options.

Apart from standing in their own right as a measure of 'first-round' direct impact, the results of the microsimulation comparisons were also used as an input into the macroeconomic analysis of the tax reform options. The macroeconomic analysis was undertaken using the Institute's IMP model which incorporated indices of income distribution in the household expenditure equations.

2.2.2 Comparison of Poverty Incidence: 1981–82 and 1985–86

This work was motivated by the widespread conjecture at the time regarding the extent and incidence of poverty in Australia, compared to the situation in 1981–82 (which was the most recent period at the time for which reliable information was available—from the 1981–82 IHS).

The basis for the comparison was an estimate of the distribution of disposable incomes in 1985–86 using a microsimulation update of the 1981–82 IHS annual income data. This was done through an elaboration of the techniques employed in the analysis of tax reform options described above. The elaboration primarily concerned the inclusion of greater detail in the treatment of demographic change and social security incomes. This latter aspect included imputation of the introduction of Family

Income Supplement (FIS) in 1983 including consideration of an estimated 25 per cent take-up rate for the payment.

Results of the comparison were reported in King (1986) and the analysis was also considered in the context of general applications of microsimulation techniques in King (1987a).

With the subsequent availability of unit record data from the 1986 IDS, it became possible to compare the microsimulation estimate of 1985–86 poverty incidence with an estimate based on survey data. The survey-based estimates for 1985–86 were reported in NIEIR's Social Policy Research Unit Newsletter No. 14 (NIEIR, 1988) and, after allowance was made for the revision of the poverty line which had taken place after the microsimulation estimate was made, showed the microsimulation estimate to have been good.

2.2.3 Projections of Housing Affordability

NIEIR was commissioned in 1987 by the Victorian State Advisory Committee on IYSH (International Year of Shelter for the Homeless) to undertake a study to identify possible alternative Australian and Victorian housing futures.

Part of this work entailed the development of three long-term economic scenarios and discussion of their implications for housing, including the need for housing assistance. A key part of this aspect was a projection of income distributions under the alternative economic scenarios. This was done through microsimulation of the annual income data from the 1986 IDS, updating to 1991, 1996, 2001 and 2006 with reference to key characteristics of the long-term economic scenarios.

Although 'static' microsimulation is generally reserved for applications over periods up to around 5 years, this restriction is largely a reference to the limits of reasonable forecasting accuracy. In the case of projections (as distinct from forecasts), which specify an outcome given a certain set of conditions, 'static' microsimulation techniques can be applied over quite long periods. The Housing Futures study (Manning, King and Yates, 1988) illustrated this extended role for 'static' microsimulation.

3. STATIC MICROSIMULATION OF CURRENT INCOMES

3.1 The Static Model for Current Incomes

Most of the static microsimulation applications at NIEIR have been undertaken with a current (weekly) income database. This has been due to the need to simulate in detail the operation of the social security system which, because of the nature of income-testing, is more straightforward with a current income than annual income data base.

With a concentration of work on the current income static microsimulation model, it has been this model which has also seen the development of increasing sophistication in other areas besides social security incomes. Many of these developments can, nevertheless, be transferred to the annual income static simulation model if required.

The basic methodology and techniques used in the current income static microsimulation model have been documented in detail in King (1988a) with reference to an updating of the 1981–82 IHS data to July 1987.

The structure of the current income static microsimulation model does not differ from the annual income version, though the level of detail and sophistication does. The main differences between the two models at present are, in terms of the characteristics of the current income model:

1. a more direct method for reweighting according to demographic and labour market change (enabled by the availability of appropriate ABS data);

2. a far higher degree of disaggregation of private income components (though transfer of this property to the annual income model would be straightforward); and

3. modelling of the social security system largely through imputation with detailed consideration of eligibility rules and income tests.

The techniques described in King (1988a) have provided the basis for the current income static microsimulation applications by NIEIR, though there have been subsequent refinements in some areas and specific elaborations in line with the nature of particular studies.

3.2 Applications

3.2.1 Changes in Disposable Income: 1982–87

A concern with the pattern of changes in disposable incomes (nominal and real) over recent years prompted the first application by NIEIR using a microsimulation model developed for use on the basis of weekly income data. For this purpose, a series of distributions of disposable incomes were estimated using microsimulation updating of the current (weekly) income data from the 1981–82 IHS. A distribution was estimated for July of each year from 1982 to 1987. The findings were presented at the May 1987 Short Term Forecasting Conference held by NIEIR and the work is summarised in King (1987b).

3.2.2 Victorian Poverty Incidence

One of the four priority areas identified in the Victorian Government's Social Justice Strategy (Government of Victoria, 1987) was the issue of children in poverty. An estimate of the incidence of child poverty in Victoria in July 1986 was commissioned from NIEIR to contribute to development of the Strategy.

The estimate was made using a microsimulation update of the current income data in the 1981–82 IHS to July 1986. This microsimulation application was the first undertaken by NIEIR at the State, rather than national, level. As such, its development required amendment of the techniques in line with differences in the availability of key data at the State and national levels.

3.2.3 Tax-transfer Platforms of the Major Parties in 1987

Prior to the 1987 Federal election, the Australian Institute of Family Studies (AIFS) undertook analyses of the distributional impacts of the tax-transfer platforms of the Liberal and Labor Parties. NIEIR worked jointly with AIFS in this work with particular involvement in the microsimulation component of the analysis.

A key element of the analyses was comparison of the simulated distributional impacts of the party platforms with a base estimation of the distribution of current incomes as at July 1987. The base distribution was estimated through microsimulation updating of the 1981–82 IHS. The Party platforms were then simulated through appropriate variation in the social security and income tax imputation components of the model. In the case of the Liberal Party platform, the analysis also incorporated valuation, albeit at a broad level, of the incidence of expenditure cuts (based on data from the ABS Fiscal Incidence Study 1987).

The analyses were reported in Maas, Brownlee and King (1987a, 1987b).

3.2.4 Impact on Poverty of the 1987 Family Package

A central aim of the Federal Government's Family Package, introduced in 1987, was a reduction in the incidence of child poverty. A detailed assessment of the likely impact of the package on child poverty was undertaken in a joint project by AIFS and NIEIR.

The central technique in the assessment was microsimulation with an elaboration of the work previously undertaken to assess the Labor Party's 1987 tax-transfer platform. The elaboration included, firstly, a revision of the estimated July 1987 income distribution on the basis of more recent official data or forecasts becoming available. Most importantly, however, this work added considerable attention to the issue of take-up rates of social security payments and the related issue of the reliability of data for some of the low-income population in the 1981–82 IHS.

Following presentation at a conference on child poverty in 1988, this assessment of the Family Package has been reported in Brownlee and King (1989). Technical aspects of the work are described in a separate paper (King, 1988b).

The technical paper also includes a comparison of estimated income distributions obtained using, firstly, microsimulation techniques and, secondly, the alternative extrapolation approach. The estimations, made on the basis of data from the 1981–82 IHS, referred to late 1986 and were compared with the initial published results from the 1986 IDS. As would be expected, there was little difference between the two estimation techniques at an aggregate level, but the microsimulation technique appeared clearly superior for more detailed analysis.

3.2.5 Costing of Alternative Pension Proposals

In 1989, NIEIR undertook a costing of a package of Age Pension changes under consideration by the Australian Retired Persons' Association. The work is reported in King (1989).

The costing was based on microsimulation including an update of the current income data in the 1986 IDS and then simulation of the pension changes under consideration. The analysis covered the impacts on both social security outlays and income tax receipts.

With a costing estimate required for 1988-89, the microsimulation involved the estimation of two current income distributions, referring to the two regimes of social security rates prevailing over the 1988-89 financial year. Because of the incomplete coverage of the population by the income survey data, Department of Social Security benchmark data was also provided for calibration of the results.

3.2.6 The Incidence of State Concessions

NIEIR has undertaken two studies using microsimulation of the incidence of State concessions: the first in 1988 for the Victorian Department of Management and Budget (King and Manning, 1988), and the second in 1989 for the New South Wales Cabinet Office (King and Manning, 1989).

Both these studies involved microsimulation updating of the current income data from the 1986 IDS and considerable detailed work imputing the take-up and value of the major State concessions.

In the Victorian case, the detailed incidence analysis was undertaken on the basis of the 1986 IDS data with microsimulation used to provide a projection of the incidence and value of concessions for each subsequent year to 1991. In the New South Wales case, the incidence analysis was undertaken on the basis of a pair of estimated distributions of current disposable income which were updated from the 1986 IDS to reflect circumstances in 1988-89.

4. DYNAMIC MICROSIMULATION

4.1 The Nature of Dynamic Microsimulation

An outline of the characteristics of dynamic microsimulation was provided in Section 1.2 above. A more comprehensive picture is presented here.

4.1.1 Dynamic Ageing

With dynamic ageing, each individual record in the microdataset is considered separately, and each of a number of demographic and socio-economic processes is explicitly simulated for the individual. These processes relate, for example, to individual survival (mortality and fertility), income unit and household formation or dissolution, labour market status, education, private incomes, social security, taxation, expenditure, saving, housing, and other asset accumulation.

While each individual is considered separately, reference is of course made to other individuals, such as a spouse, where relevant.

The simulation of these processes is largely achieved by specifying the model in terms of events (such as death, job change, or retirement) with sets of probabilities attached to each event. The probabilities determine the likelihood of a particular event taking place in the period under consideration. For any given event, the associated probabilities are typically conditional on a number of attributes of the individual. Simulation of an event then works by drawing a random number and comparing this with the associated probability relevant to the individual. Depending on the relationship between the two, the event is deemed to either happen or not. This is known as Monte Carlo simulation.

A simple example of Monte Carlo simulation in a dynamic microsimulation is the event of death. Suppose demography tells us that the probability of death during the next year for an individual with certain characteristics is 10 per cent. A random number between zero and one is drawn and if that random number is less than or equal to 0.1 then the individual is deemed to have died in that year. Otherwise, the individual is considered to have survived.

4.1.2 Advantages Over Static Microsimulation

Application of this technique of 'Monte Carlo' event simulation enables complex multivariate processes to be suitably approximated and behavioural assumptions to be easily accommodated and varied. This ageing procedure leads to three important advantages over static microsimulation.

1. Firstly, structural change in the population can be satisfactorily modelled. In static microsimulation, structural change in the population (the relationship between various population attributes) can only be fully incorporated to the extent that multivariate tabulations are available to govern the reweighting process. The scope of such tabulations tends, however, to be quite limited. The coverage of structural change in static microsimulation can be extended somewhat through multi-stage reweighting processes though these are awkward and risk inconsistencies. The multivariate approach under dynamic microsimulation, on the other hand, allows consideration of the interactions among a far greater number of variables.

2. Secondly, this explicit method of modelling behavioural processes allows the straightforward incorporation of behavioural responses in dynamic microsimulation. Static microsimulation models tend to be restricted to the first-round effects of a change in, say, the tax-transfer system. Some second-round effects, such as on labour supply in this example, can be incorporated in a static microsimulation model but not with the ease possible with a dynamic model.

3. The fundamental output of a dynamic microsimulation is a new microdata file, whose members may have changed their individual situations quite considerably as a result of the run. As with a static microsimulation, distributions of particular attributes can then be derived and compared to assess the impacts of policy measures or changed conditions. However, the output from a dynamic microsimulation run has the added property that the new data file can be matched at the level of the individual unit to the original data file. A series of dynamic microsimulation runs can thus generate a longitudinal sample, whereas a static microsimulation would produce a series of cross-section samples.

4.1.3 Preliminary Data Analysis

Construction of a comprehensive dynamic microsimulation package obviously represents a major research undertaking, with every area of activity for decision-taking requiring detailed analysis if the final product is to be realistic and internally consistent. The first such package developed in the United States ('DYNASIM') took well over a decade to produce, though more recent international efforts have taken less time (at least in part as their designers have capitalized on earlier experience). Overseas applications of dynamic microsimulation in the past two decades have been in such areas as housing, demographic projections, health and energy policy, assessing wealth distribution, analysing the costs and benefits of the social security system in the United States, and in assessing the impacts of pension reform and changes to hours worked in West Germany.

The potential for complexity in dynamic microsimulation can be illustrated by reference to DYNASIM. In that model, for example, the probability of death occurring in any given year is related to the age, sex, race, marital status and education of the person concerned and, if a woman, to the number of her children. Fertility is related to the age and marital status of the woman concerned, to the number of children she has already, and to her race and level of education. The propensity to separate or divorce is related to marriage duration, age, race, and labour market status of both partners. The propensity to marry is related to age, sex, race, education, labour market status, and whether the person had been married before. Economic variables such as wage rates, labour force participation, hours spent in the labour force, and likelihood of unemployment are all related to a similar array of attributes (and to each other).

Establishing such relationships for incorporation in a dynamic microsimulation model requires substantial preliminary data analysis. The data used to derive these relationships, in terms of the parameters against which random numbers are compared when simulating, necessarily come from any useful source—from the microdatabase itself, from other cross-sectional survey results, or where possible from longitudinal data sets. The derived probabilities may be expressed in simple tabular form, or as formal statistical distributions, as regression equations, or as transition probabilities.

Not all processes in the dynamic microsimulation model are modelled with Monte Carlo techniques. There are some areas, notably the tax-transfer system, where mechanistic processes prevail and are modelled in a deterministic manner. Nevertheless, even here there is scope for enhancement through

Monte Carlo simulation to take account of behavioural aspects such as the take-up of social benefits or the evasion of tax liabilities. Preliminary data analysis is accordingly also needed here.

There are further steps in the preliminary data analysis that may be required. There is the possibility that some variables may need to be imputed from other data sources directly into the data base. Also, certain aggregate parameters may need to be set exogenously, such as migration rates or unemployment rates, indicating the importance of formal linkages between the microsimulation model and a macroeconometric model in order that micro-based outcomes will be consistent with some overall macroeconomic view.

Both data preparation and macro-model linkage are typically very involved processes.

4.1.4 Some Technicalities

A number of other issues characteristic of the dynamic approach must be considered in constructing a dynamic microsimulation model. For example, Monte Carlo methods introduce a source of variation in the simulation results attributable to variation in the random number sets used for different runs. This complication can be avoided however by ensuring that the same set of random numbers is used, so that the same number is drawn for the same sample member at the same stage of their simulation in each run, a step also enabling run parameters and probabilities to be more confidently manipulated, and sample sizes to be smaller for any given level of precision.

The order in which processes are considered in the overall simulation can be important. This is the case, for example, with the order of testing for giving birth and divorce for a married couple. These are events for which the occurrence of one reduces the likelihood of the other, so that there will be an upwards bias in occurrence of the event that is consistently considered first. The same principle applies to the order in which individuals in the same household or income unit are treated, since the occurrence of some event for one member may affect the likelihood of other events occurring for other members. These biases can be avoided by appropriately randomising the order in which events, and individuals, are considered.

Complications can also arise in the simulation of 'markets', in which separate individuals with mutually compatible requirements must be brought satisfactorily together. One obvious example is the 'marriage market', and the microsimulation model must be designed both to suitably link individuals from separate income units or households, and to establish them as a new micro-unit in the database. The package must also be able to introduce new micro-units into the data set as a result of events such as young people leaving home or marriages terminating.

Finally, a fully operational and comprehensive dynamic microsimulation model consists of vast amounts of data, and huge numbers of comparisons and computer operations. Thus, appropriate programming, which will ensure flexibility, maintainability and efficiency, is of the utmost importance (Hellwig, 1989).

4.2 Potential Applications of Dynamic Microsimulation

Three important characteristics of dynamic, as compared to static, microsimulation were noted above. These were the capacity to incorporate structural changes in the population, the ability to handle behavioural processes, and the capacity to generate a longitudinal sample. These characteristics point to those areas where a dynamic microsimulation has particular strengths:

1. Where there is a need to incorporate consideration of structural changes;
2. Where there is a need to incorporate consideration of behavioural responses or change;
3. Where there is a need to consider the circumstances of individual units of the population over a number of years.

The first and second points indicate the usefulness of dynamic simulation for considering distributional changes over longer than the short-term or where significant behavioural responses to change may be anticipated. The limitations of static microsimulation with regard to structural and behavioural change only arise over a period where such changes are likely to be significant. It is widely held that these factors do not constitute a problem with short-term static simulations over a period of up to around five years or so. For periods in excess of this, the preferability of using a dynamic model increases rapidly.

The third point suggests the usefulness of dynamic microsimulation for a whole range of issues which are better analysed through a longitudinal approach than through cross-sectional analysis. These essentially comprise issues of accumulation:

1. Accumulation of physical assets
   - housing
2. Accumulation of financial assets
   - savings and superannuation
3. Accumulation of human capital
   - education
   - training

It should be readily apparent what a powerful tool a dynamic microsimulation model can provide, not only for addressing policy issues in the above areas which static approaches can not handle or over the medium to long term, but also by elaborating the types of analyses obtainable from static approaches with findings on, for example, the extent to which poverty or low wages are and are not a temporary phenomenon in people's lives.

Though the research demands in the development of a dynamic microsimulation model are great, the rewards to the analyst in having such a tool are considerable. It encourages the researcher to explicitly consider all relevant demographic and socio-economic processes. When these are satisfactorily modelled, a dynamic microsimulation can provide extremely rich and comprehensive results.

4.3 The NIEIR Dynamic Microsimulation Model

Preliminary work at NIEIR on the development of an Australian dynamic microsimulation model commenced in 1986. During 1988 and 1989, with some assistance provided through an ARGS grant, a computer program to perform dynamic microsimulation was prepared and tested at NIEIR. At this stage, the model comprises an operational logical framework with most attention having been paid to date to incorporation of demographic, labour market, and superannuation processes. The basic tax-transfer modules are directly transferable from those used in the static microsimulation models at NIEIR.

The present status of the dynamic model can be summarised as follows:

- The base data set comprises selected variables from the unit record data from the 1981–82 IHS. Some additional variables, such as the single-year ages of dependents, have been added through imputation. The processes can be readily applied to the unit record data from the 1986 IDS if required, though with some loss in the quality of data in the areas of superannuation and housing.
- The basic unit for simulation analysis is the income unit though with simulation of processes for individuals within the income unit in many instances.
- The model is written in Fortran and is run on a VAX computer under the VAX/VMS operating system. A Basic version is available but running time is significantly longer.
- Income units are processed sequentially in the data set, with male and female adults in two-adult income units treated in random order.
- Demographic processes are considered first, followed by possible labour market transitions (including superannuation), and then the tax-transfer system.
- Demographic processes are simulated on the basis of probabilities derived from various ABS series of demographic statistics. The various processes modelled include:
  - Children losing dependent status and forming new income units.
  - Death, which, in the case of an adult, will see a two-adult income unit become a single-adult income unit or a single-adult income unit cease to exist (in which case, the 'dead' income unit can be stored in a 'cemetery' file for later reference if needed). Certain variables, such as asset incomes, are adjusted for a surviving partner.
  - Separation/divorce, leading to the formation of two income units from one.

  - Birth.
  - Marriage, which is modelled through two steps: firstly, establishing a propensity to marry and, secondly, attempting to find a suitable partner from a temporary file of provisionally unmatched persons.

- The labour market processes that are modelled include:
  - Transitions between full-time employment, part-time employment, unemployment and labour force non-participation.
  - Change of employment.
  - Assignment of industry, sector and employee status in the cases of a move into employment or a new job.
  - Earnings.
- The probabilities incorporated in the modelling of labour market processes have been derived from ABS gross flows data and the 1981–82 IHS.
- Superannuation is modelled on the basis of:
  - Initial coverage.
  - Probability of coverage in a new job.
  - Various parameters, including the relationship between final earnings and retirement benefits, the preferences for lump-sum and pension schemes, and the rate of return on investments.
- The tax-transfer system (government cash benefits and income tax) is modelled in a mechanistic manner akin to that used in the static microsimulation.

Clearly, there is still some way to go before the full potential of a dynamic microsimulation model can be gained. What is needed is further sustained research to elaborate the processes incorporated in the model and to derive or estimate the full range of required probability distributions and parameters. Nevertheless, the model has reached the stage in development where it is operational if only at the level of illustrative examples.

4.4 An Illustrative Example

The processes of the dynamic microsimulation model are illustrated here in terms of an exercise which was designed to test various aspects of the model. The exercise concerned using the model to predict the impact over the long-term on the number of age pensioners which would stem from a substantial increase in superannuation coverage. The change modelled entailed providing superannuation with all new jobs (that is, where people move into employment or change jobs) from 1983.

The simulation used a subset of 2000 income units from the 1981–82 IHS base data and was run for 25 year periods (1982 to 2007). One set of 25 runs referred to a base case in which superannuation coverage for new jobs was set at levels experienced in the early 1980s, while the second set of runs included universal superannuation coverage. The processes and results of the exercise are presented below, mainly for the first ten years of the simulation. It should be remembered that this was an illustrative hypothetical exercise. These are not 'findings'.

Table 1 indicates the outcomes of the demographic processes in the model. The first part of the table shows the numbers (unweighted) of income unit heads and spouses with additions through dependent children becoming independent and subtractions occasioned by deaths. The table also shows the numbers of divorces and births simulated in each year and, finally, the outcomes of the marriage process. The figures on marriages show the numbers of individuals deemed eligible, the numbers of successful matches, and the numbers of unsuccessful marriage aspirants. Tables 2 and 3 respectively show the outcomes with regard to the age and labour market structures.

Table 4 shows the different outcomes from the two sets of runs over the first 10 years of the simulation with regard to superannuation coverage and receipt of Age Pension. The table refers to income unit

Table 1 **Demographic Change, 1983 to 1992: Income Unit Heads and Spouses, Unweighted Counts (2000 Income Units in 1982)**

	1983	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*
(1) Individuals										
Initial Number	2989	3066	3111	3155	3201	3251	3295	3335	3358	3379
+ additions	103	73	85	69	76	76	72	61	74	63
=	3092	3139	3196	3224	3277	3327	3367	3396	3432	3442
– deaths	26	28	41	23	26	32	32	38	53	28
= Final Number	3066	3111	3155	3201	3251	3295	3335	3358	3379	3414
(2) Divorces	16	17	14	15	12	24	24	19	13	22
(3) Births	33	29	29	36	29	23	29	31	20	19
(4) Marriages										
seeking (persons)	69	66	66	97	93	86	73	83	94	83
matched (couples)	29	24	28	41	37	40	28	33	35	34
unmatched (persons)	11	18	10	15	19	6	17	17	24	15

Table 2 **Age Structure Change, 1982 to 1992: Income Unit Heads and Spouses, Weighted Counts (2000 Income Units in 1982)**

Age group	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*
					(per cent)						
20-39 years	47.5	47.9	48.2	48.0	47.1	46.1	46.1	46.3	45.3	45.5	45.1
40-64 years	39.4	38.8	37.7	38.2	38.5	39.5	39.3	39.7	40.9	41.0	40.8
65+ years	12.9	13.4	14.2	13.9	14.5	14.6	14.5	13.8	13.9	13.7	14.4

Table 3 **Labour Market Change, 1982 to 1992: Income Unit Heads and Spouses, Weighted Counts (2000 Income Units in 1982)**

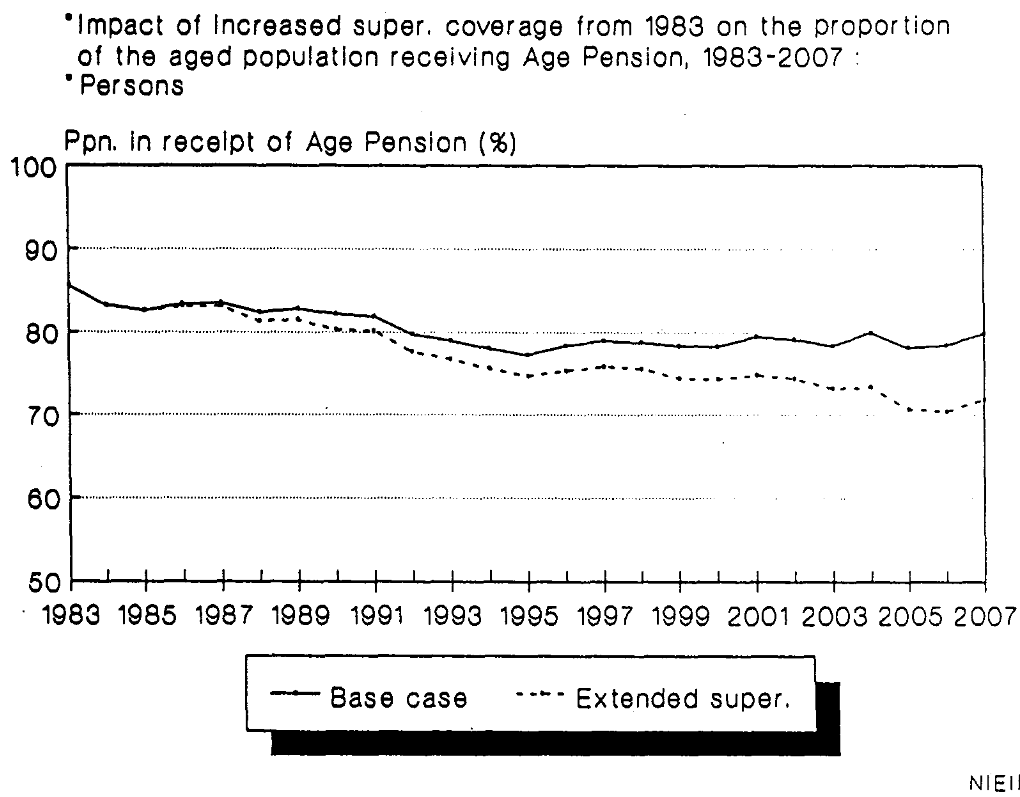
	1982	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*
					(per cent)						
Full-time employment/ population	50.4	49.5	48.4	48.0	48.2	46.2	46.8	47.0	46.4	46.1	47.6
Part-time employment/ population	9.6	9.5	9.8	10.4	10.1	10.9	10.2	9.8	10.7	11.2	11.3
Employment/ population	60.0	59.0	58.2	58.4	58.3	57.1	57.0	56.8	57.1	57.3	59.0
Unemployment/ population	4.8	3.6	3.9	4.6	4.1	4.0	4.2	4.3	3.9	4.4	3.8
Participation rate	64.8	62.6	62.1	63.0	62.4	61.1	61.2	61.1	61.0	61.7	62.8
Unemployment rate	7.4	5.8	6.3	7.3	6.6	6.5	6.9	7.0	6.4	7.1	6.1

Table 4 **Superannuation and Age Pension Coverage, 1983 to 1992: Income Unit Heads and Spouses, Weighted Counts.**

	1983	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*
					(per cent)					
(1) Base case										
Imputed superannuation coverage by length of cover:										
0 years	72.8	69.8	67.6	65.5	63.7	61.8	60.1	58.9	57.3	56.2
1-5 years	9.3	12.0	14.1	16.0	17.3	18.0	17.9	17.0	15.8	14.1
5-20 years	10.3	10.2	9.9	9.6	9.9	10.8	12.3	14.4	17.1	19.8
20+ years	7.6	8.0	8.4	8.9	9.1	9.4	9.7	9.7	9.8	9.9
Proportion of elderly (a) in receipt of Age Pension:										
males	82.3	79.6	78.6	81.1	81.3	77.4	78.3	79.3	77.1	75.6
females	87.7	87.4	85.8	86.0	85.6	84.5	85.8	86.1	86.2	84.0
persons	85.8	84.4	83.1	84.1	84.1	81.9	83.2	83.7	83.1	81.0
(2) Increased superannuation cover:										
Imputed superannuation coverage by length of cover:										
0 years	65.3	58.9	54.4	51.0	47.8	45.5	43.5	41.2	39.3	37.2
1-5 years	16.2	22.2	26.6	29.8	31.2	28.3	24.6	22.4	20.1	18.4
5-20 years	10.7	10.7	10.2	9.8	11.5	16.4	21.7	25.8	29.7	33.0
20+ years	7.8	8.2	8.8	9.4	9.5	9.8	10.2	10.6	10.9	11.4
Proportion of elderly (a) in receipt of Age Pension:										
males	82.3	79.6	78.6	81.1	81.3	76.8	77.7	78.6	76.4	74.4
females	87.7	87.4	85.8	86.0	85.6	84.5	85.8	86.1	86.0	83.5
persons	85.8	84.4	83.1	84.1	84.1	81.7	82.9	83.4	82.7	80.3

Note: (a) Males 65 years and over, females 60 years and over

Figure 1: **Illustrative Example Using Dynamic Simulation**



heads and spouses and, for each case, firstly shows the proportions of the population with superannuation coverage, further classified by duration of coverage, and secondly shows the proportion of people in the relevant age group who receive Age Pension. The absolute figures in the table are not so important. For example, it is not a concern in this exercise whether the Age Pension proportions tally with official data. What is of interest is the relationship between the change in superannuation coverage and the change in Age Pension receipt.

The table shows the only slight reduction in Age Pension receipt (by 0.7 percentage points) which would be obtained 10 years after the expansion of superannuation coverage. This is despite the proportion of the adult population with superannuation coverage rising by 1992 to around 20 percentage points higher than it would otherwise have been. The reason for the slow response is of course the years needed before superannuation coverage will lead to a sufficient accumulation to prevent receipt of Age Pension.

After 25 years, however, the impact has become more significant. Figure 1 gives the results of the simulation run over 25 years and shows a fall in the proportion of Age Pensioners of around eight percentage points by 2007 following the introduction of universal superannuation coverage in 1983.

The results of this illustrative exercise were considered encouraging, especially considering the relatively unsophisticated procedures incorporated in the model at present. The overall results appear quite plausible and, in particular, the age breakdowns and labour market stock ratios generated for the late 1980s coincide well with actual outcomes.

5. LINKING MICRO AND MACRO MODELS

5.1 Value of a Macro-Micro Linkage

Establishing a formal link between a macroeconomic and a microsimulation model has potential benefit for both.

A microsimulation model can benefit from linkage with a macroeconomic model in a number of ways, for example:

1. where a forecast or projection of external economic parameters is required for ageing the microsimulation model,
2. where there is a need to take into account those second-round effects which appear as distributional consequences of the macroeconomic ramifications of the initial change under consideration.

A macroeconomic model can benefit from linkage with a microsimulation model where the behaviour of macroeconomic aggregates is dependent on the distributional pattern among units within the aggregate group. For example, the expenditure pattern of the household sector is dependent on the distribution of incomes within the sector.

5.2 NIEIR Work To Date on Macro-Micro Linkage

The NIEIR macroeconomic models are well suited to linkage with microsimulation models since the former incorporate explicit reference to time, a characteristic noted above as one of the important properties of microsimulation. Thus, the macroeconomic models are designed to allow the time-path of adjustment to be traced in a realistic manner.

The possibilities for extending the linkage between the NIEIR macroeconomic and microsimulation models have been under consideration for some time, including examination of the alternative forms of possible linkage (Hellwig, 1990b). One possible type of linkage, for example, could be one which operates in both directions in a recursive manner. The linkages used at NIEIR to date have, however, been relatively simple and uni-directional.

5.2.1 Macro Input to Micro

The extent of macro-model input to microsimulation at NIEIR has been limited to date to use of macroeconomic model output as one source for the external economic data needed for the static microsimulation model. Such data includes, for example, labour market aggregates, components of household income, average earnings and the consumer price index. This form of linkage is used frequently in the microsimulation analyses, not only when the assessment involves forecasting, but also to provide current economic data which is not yet available due to the lags in availability of official statistics.

5.2.2 Micro Input to Macro

One example of using microsimulation output as input to a macroeconomic analysis was the assessment of tax reform options discussed in Section 2. A second example has been the work undertaken at NIEIR using microsimulation to improve the aggregate consumption equations in the Institute's IMP economic model.

This work, described by Perkins (1989), involved estimation of a 20-year annual series of household expenditure distributions through 'static' backdating and updating of the 1984 HES data. The estimated series of distributions was then used as a hypothetical construct which indicated the contributions of changing demography and income distribution (as opposed to changes in tastes and prices) to observed changes in aggregate consumption over the period. 'Demographic expenditure indices' were derived from the work and used as explanatory variables in the IMP aggregate consumption equations.

6. SOME LESSONS FROM THE NIEIR EXPERIENCE

1. *Development of a microsimulation model needs to be undertaken with a clear view of its intended purposes.* As an academic exercise, the task of developing a microsimulation model would be potentially endless, there always being scope for further sophistication. With a model being developed for pragmatic purposes, on the other hand, it is essential to distinguish between those matters which are important for the intended analyses and those which are not. Developmental work can then concentrate on providing the best possible detail and sophistication for key aspects of the model while less important aspects can be handled in a relatively simple manner.

   The corollary of this approach is that microsimulation model development tends to be driven by its applications. This has been the case with the experience at NIEIR. From a basic framework, the model is progressively elaborated along a path which reflects the requirements of each particular practical application.

2. *Use of microsimulation requires a clear understanding of the base data and of the processes incorporated in the model.* This is essential for valid interpretation of the results of a microsimulation analysis, with due recognition given to any relevant limitations of the model. Such limitations could derive either directly from the original data base or from the modelling framework applied to that data base. Put simply, the output from the model is only as good as what goes in.

3. *Data limitations impose an important constraint on the scope of microsimulation, but this is not a binding constraint.* The absence of required data can lead to two responses: lobbying for the data to be collected and, failing this or pending its success, imputation or estimation of missing data. Where the latter approach is taken, however, there needs to be a clear statement of what has been done. The basis for judgement as to whether or not an imputation is appropriate partly relates to the next point.

4. *Validation is an important element in development of a microsimulation model.* Microsimulation has the potential to attain a high degree of accuracy. This does require, however, that constant attention be given to validation of all aspects of the model: comparison of simulated and actual outcomes with regard to overall results and particular components of the model.

5. *Microsimulation is a complement to other methods of distributional analysis.* The fact that a research question can be addressed through the use of microsimulation does not mean that microsimulation is necessarily the best approach. Different approaches have their own particular strengths and weaknesses. A particular question may not warrant the sophistication of a microsimulation analysis. Similarly, a dynamic microsimulation analysis is not always superior to a static microsimulation analysis when pragmatic considerations are taken into

account. The choice of technique needs to be decided for each application on its own merits. On the other hand, there is often no reasonable alternative to the use of microsimulation.

6. *Microsimulation is an area where there is much to be gained through collaboration by research teams.* To an extent, any group using microsimulation should work through the tedium of the basics in order to gain the necessary familiarity with the data and processes. There comes a point, however, where insular developmental work becomes quite inefficient. With collaboration among researchers, the outcome is likely to be a far higher level of sophistication overall with, perhaps, different groups specialising in different areas.

7. THE NIEIR PROGRAM OF WORK ON MICROSIMULATION.

NIEIR is continuing to expand its activities in the area of microsimulation, with this expansion planned for a number of directions:

1. the static microsimulation model,
2. the dynamic microsimulation model,
3. macro-micro linkage,
4. a regular microsimulation working party.

7.1 The Static Microsimulation Model

By now, the static microsimulation model is an established element in the range of analytical tools used for research at NIEIR. Still, there is always scope for improvements in detail and sophistication. It is envisaged that further elaboration of the model will largely follow the same course taken to date; that is, be steered by the particular applications for which it is being used.

7.2 The Dynamic Microsimulation Model

The dynamic microsimulation model has not yet reached the stage of development where it can be usefully applied in research applications. Attainment of this stage is the current priority for work on the model. This will entail further work on model specification and, in particular, on continuing with the considerable preliminary data analysis required for a dynamic microsimulation model.

7.3 Macro-Micro Linkage

Work is proceeding at NIEIR on establishing formal linkage between the microsimulation and macroeconomic models. The potential value of such linkage was set out in Section 5, as was the suitability of the form of the NIEIR macroeconomic models for linkage with microsimulation. This line of development is being followed with an objective to enhance both the micro- and macro-models.

7.4 Regular Microsimulation Working Party

An important element of the economic forecasting and analysis role of NIEIR is the staging of regular conferences or working parties concerning particular matters; for example, short-term forecasts, long-term projections, the State economies, or the energy industries. The purpose of these meetings is two-fold: firstly, to provide regular forecasts and other research findings and, secondly, as forums for discussion.

The value of establishing a regular working party on household economics on roughly similar lines has been under consideration for some time. NIEIR is currently planning to proceed with the idea jointly with the Centre for Applied Research on the Future (CARF) at the University of Melbourne. CARF has devoted much effort in recent years to extending the measures of household economics to include those activities normally excluded by conventional measures.

A first working party would be likely to be held in mid-1991. The content of the meeting, or indeed whether there is a meeting at all, will depend on the interests of participants. Participants would potentially be drawn from those organisations with an interest in the broad range of analyses where microsimulation has particular strengths. At this stage, it is envisaged that the working parties would be held twice a year and would include a core of regular output (for example, distributional forecasts linked to the short-term and State forecasting at NIEIR), discussion of current policy issues including recent research results, and methodological and technical issues.

REFERENCES

NIEIR Consultancy reports

(Any request for copies of these reports should be directed to the relevant commissioning body)

Brain, P., Fung, W., King, A. and J. Perkins (1985), *Reform of the Australian Tax System. Paper Two: A Quantitative Evaluation of the Income Distribution and Macroeconomic Effects*, a report to the Australian Council of Trade Unions.

King, A. (1989), *Costing of ARPA Proposals for Australian Aged*, a report to the Australian Retired Persons Association.

King, A. and I. Manning (1988), *Victorian State Concessions: Their incidence and projected value*, a report to the Department of Management and Budget, Victoria.

King, A. and I. Manning (1989), *The Incidence of State Concessions in New South Wales*, a report to The Cabinet Office, NSW.

Manning, I., King, A. and J. Yates (1988), *Housing Futures*, a report to the Victorian State Advisory Committee for the International Year of Shelter for the Homeless.

OTHER REFERENCES

Brownlee, H. and A. King (1989), 'The estimated impact of the family package on child poverty', in *Child Poverty in Australia*, D. Edgar, D. Keane and P. McDonald (Eds), Allen and Unwin, Sydney, pp. 123-45.

Harding, A. (1990), *Dynamic Microsimulation Models: Problems and Prospects*, Paper presented at the British Sociological Association Annual Conference, University of Surrey.

Hellwig, O. (1989), *Programming a Microanalytic Simulation Model Using Software Engineering*, Fourth International Symposium on Computer Simulation in the Social Sciences, Nuremberg.

Hellwig, O. (1990a), *The Overseas Experience with Microsimulation Models*, this volume.

Hellwig, O. (1990b), *Linkage of Microsimulation and Macroeconomic Models*, NIEIR Working Paper, forthcoming.

Government of Victoria (1987), *People and Opportunities: Victoria's Social Justice Strategy*, Government of Victoria, Melbourne.

King, A. (1986), 'An Estimate of the Extent of Poverty in Australia in 1985–86 Using Microanalytic Simulation Methods', in Council of Social Welfare Ministers Income Support Seminar, Melbourne, 8–9 December, pp. 127–38.

King, A. (1987a), 'Analysing the distributional consequences of policy: the uses of microanalytic simulation methods', *National Economic Review*, *6*, February, pp. 7–28, .

King, A. (1987b), *Short-term Income Distribution Forecasting: Notes on Derivation of Australian Income Distribution Series from July 1982 to July 1987*, unpublished paper, NIEIR, Melbourne.

King, A. (1988a), *The Distribution of Current Disposable Incomes: an Estimation Using Techniques of Microanalytic Simulation*, NIEIR Working Paper No. 1, National Institute of Economic and Industry Research, Melbourne.

King, A. (1988b), *Assessment of the Impact of the Family Package on the Incidence of Poverty: Technical Notes*, unpublished paper, Australian Institute of Family Studies, Melbourne.

Maas, F., Brownlee, H. and A. King (1987a), *Assessment of the Impact of Tax Reforms Proposed by the Liberal Party of Australia in June 1987*, AFIT Bulletin No. 3, Australian Institute of Family Studies, Melbourne.

Maas, F., Brownlee, H. and A. King (1987b), *Assessment of the Impact of Changes to the Tax Transfer System Proposed by the Australian Labor Party in June, 1987*, AFIT Bulletin No. 4, Australian Institute of Family Studies, Melbourne.

NIEIR (1988), *Social Policy Research Unit Newsletter, No. 14*, November, NIEIR, Melbourne.

Perkins, J. (1989), *Patterns of Household Expenditure*, paper presented to the 1989 Australasian Meeting of the Econometric Society, Armidale.

DISCUSSION

Professor Bruce R. Bacon
Centre of Policy Studies, Monash University and
Centre for Research on Federal Financial Relations, ANU

Anthony King has provided us with an excellent review of microsimulation techniques in general along with an overview of current microsimulation activity at the National Institute of Economic and Industry Research.

Given that an overview paper, of necessity, circumvents the detail, it would be difficult for me to discuss the cited applications with any degree of confidence. I will however note the wide range of policy issues addressed, the applicability of microsimulation models to those issues and congratulate them on the progress they have made in extending dynamic microsimulation to policy analysis in Australia. It would therefore seem appropriate that I concentrate on the microsimulation techniques, raising issues of interest to me and indicating directions we have taken at COPS and CRFFR.

Let me begin by quickly addressing the wider issue of the appropriateness of microsimulation in general. Some economists have put the view that the power of microsimulation is often overstated and that the policy questions that can effectively be addressed may be limited. This criticism, of course can be levelled more easily at static rather than dynamic microsimulation.

John Piggot, in a forum focussing on static microsimulation and fiscal incidence studies held at this centre some two years ago, argued that while microsimulations can provide a valuable starting point for assessing the redistributive impact of government policies, they do not of themselves provide consistent answers about the patterns of gains and losses to particular household groups and should not be so interpreted.

He goes on to give a number of reasons for this argument:

- the system abstracts from behavioural effects
- relative prices are fixed
- consumer surplus gains from cooperative supply of public goods are ignored
- a life cycle approach is preferred to annual analysis

and that a rigorous approach requires a complete general equilibrium structure to capture this.

At that forum, both Neil Warren and myself, noted that although we recognised the desirability of the GE approach, we saw significant difficulties (if not impracticality) in constructing a GE model of the flexibility, coverage and complexity which would compete with the microsimulation models we are considering today.

Anthony's paper demonstrates the importance of dynamic microsimulation, and whilst not disagreeing with his overall thrust, I would like to extend the concept in a different direction. In doing so I would make a strong claim for a technique I call dynamic profile modelling, drawing on work we have undertaken at COPS and CRFFR.

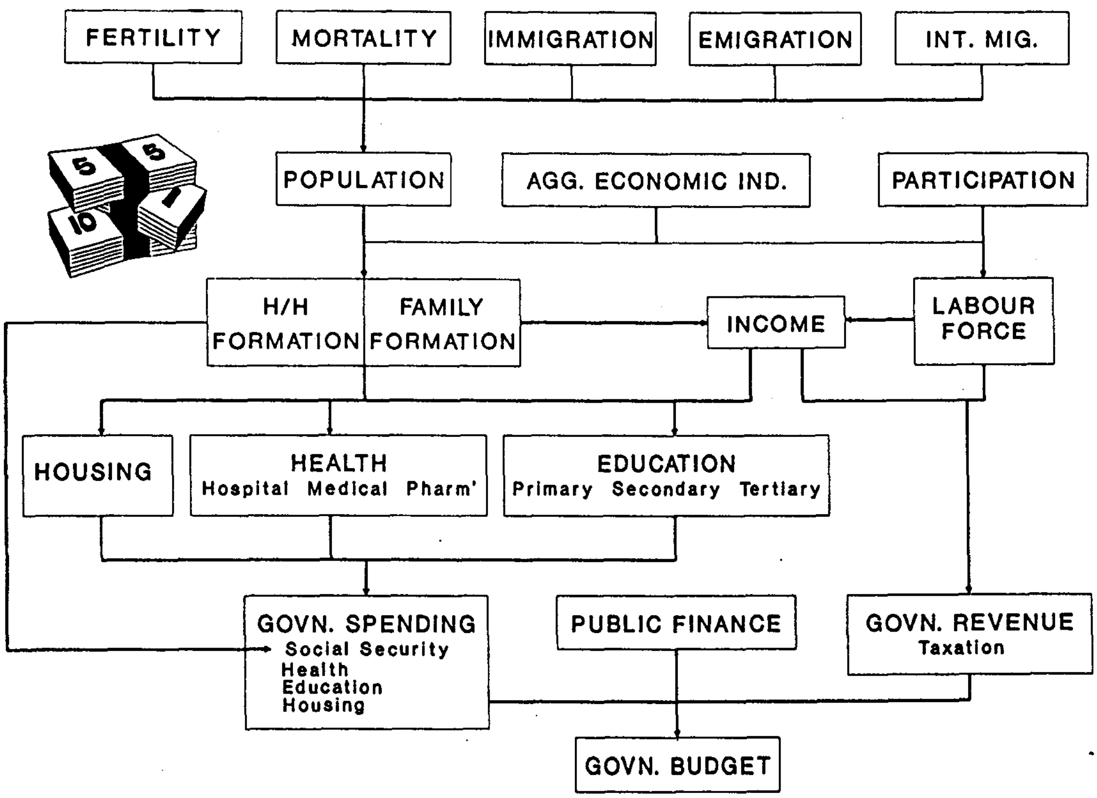
I would therefore define three types of microsimulation:

- Static Microsimulation (SPAT Model)
- Dynamic Profile Microsimulation (DMF)
- Dynamic Stochastic Microsimulation

with the last two being called dynamic because they explicitly take an intertemporal approach.

Whereas stochastic microsimulation simulates, through time, outcomes for each micro-unit on the supporting microdatabase, profile microsimulation abstracts from the unit records and simulates the demographic/economic profiles of the entire (or suitable cohort) population through time. Whilst this approach is not necessarily new, its use as a standalone framework provides considerable power in analysing in detail different sectors of the economy. Further, when combined with static microsimulation techniques, this provides a very flexible intertemporal model which I believe is simple to use and easy to modify to meet emerging research needs.

Figure 1 Dynamic Microsimulation Framework, Public Finance Version



Let me use current research at COPS/CRFFR where we have developed two microsimulation models to illustrate the potential of this approach. A static microsimulation model called SPAT (SPending and Taxing) and a dynamic profile model called DMF (Dynamic Microsimulation Framework).

The Dynamic Microsimulation Framework (see Figure 1) is a spreadsheet based analytical tool for developing future scenarios and projections at the microsimulation level. The framework consists of a set of loosely connected modules (link spreadsheets) within which alternative simulation paths can be explored. Each module can be independently constructed and/or split into new modules reflecting the level of sophistication, detail of analysis or disaggregation permitted by the data. The framework is linked to the SPAT (Spending and Taxing) static microsimulation model to provide intertemporal analysis of family and household groups.

This approach appears to me to provide a number of user advantages:

- No programming skills are required
- Spreadsheets are easy to manipulate
  are easily extended
  and are easy to understand
- New modules can be quickly constructed.

It is clear that the DMF can provide the dynamic information missing from static microsimulation. Combining the two gives a technique which anyone can use, is computationally simple, extremely flexible and, most important, can run interactively on a PC.

Now let me return to Anthony's paper and consider some of the issues he raised.

Firstly I would like to consider *intertemporal ageing*. All models that attempt to simulate through time explicitly or implicitly age the data and/or the model as they simulate out from the reference year.

Whereas Anthony distinguished two types of ageing, I see the need to capture explicitly five types of ageing.

(i) Population ageing
(ii) Family ageing
(iii) Aggregate economic ageing
(iv) Distributional ageing
(v) Policy rule ageing.

With population ageing the population weights associated with each individual are updated to reflect the actual or expected population profile of the simulation period.

In the case of family ageing, the resulting family weights are adjusted to capture aggregate family characteristics not reflected through population ageing, e.g. labour force participation.

Aggregate economic ageing scales the components of aggregate economic variables to reflect the actual or expected value of the economic variable in the simulation period, whereas distributional ageing up-dates distributional parameters to reflect the evolving aggregate distributional profiles and the profiles of their components.

Lastly, policy rule ageing covers the modelling techniques used to capture the changing historic policy regimes and the policy alternatives under investigation.

Next I want to raise some questions about *stochastic microsimulation.*

Although having worked on stochastic simulation with macroeconomic models, I have not researched, and hence thought deeply about, stochastic microsimulation. So I hope what I am going to say does not reflect my ignorance.

My first question actually came from my macroeconomic experience. Anthony states that dynamic microsimulation has the capacity to generate a longitudinal sample. To achieve this, the stochastic seed is reset to its initial value to undertake different simulation runs.

On the other hand macro-stochastic simulation emphasises replications of the same run some one hundred plus times with different stochastic seeds. This gives results on an expected time path and a measure of dispersion about that path. (Difference arises between the stochastic and deterministic time path depending on the degree of nonlinearity in the system.) This is what I call a Monte Carlo Technique.

So it was a surprise to me to see Anthony refer to their dynamic microsimulation as *'Monte Carlo'*.

In fact, I wonder what the 'once off' stochastic path traced out through time actually captures, particularly for a sub-population with small numbers of family/households contributing. (The size of our microdatabases can often lead to small sample problems.) As an aside, I note that there are many techniques available in stochastic macroeconomic modelling for speeding up the replication process, such as the covariance reduction method, which may be applicable to microsimulation replications.

When it comes to generating longitudinal samples there are some extra problems. In practice new unit records must be created and some deleted as families form and dissolve through time. These distortions, to some extent, destroy the one to one correspondence between the starting and final samples. Family and household units are therefore inappropriate units to use in longitudinal studies of this sort as they are often subject to dissolution and reformation throughout the life cycle of the sample individuals. Yet it is at the family level that welfare considerations are usually considered.

Finally, I would like to remind users that all dynamic simulation models face major methodological problems in attempting to disentangle age, cohort and period effects. The problem for longitudinal analysis is that most of the data sources used force dynamic models to reflect the combined impact of these effects.

MODELLING THE IMPACT OF LABOUR MARKET CHANGES ON THE DISTRIBUTION OF FAMILY INCOMES

Bruce Bradbury[1],
Social Policy Research Centre

1. INTRODUCTION

There are several reasons why researchers and policy makers might want to adjust household survey data to reflect different economic and policy environments. The main impetus stems from the inevitable lags in the collection, processing and release of survey data which mean that data is out of date by the time researchers are able to access it. Hence a major use of microsimulation models has been to modify this data to better reflect current circumstances. This is usually a necessary initial step before any further simulation of policy or economic changes is undertaken (see the other papers in this volume for examples).

Adjustments, however, need not be limited to such 'contemporisation'. The same methods can be used to adjust the data to refer to more than one point in time. This is particularly useful when intermittent data collection means that available survey data do not cover the periods of most interest for research or policy analysis. Previous work at the SPRC, for example, has adjusted the data from the *1986 Income Distribution Survey* to estimate the distribution of family incomes in both 1982–83 and 1989–90 (Bradbury, Doyle and Whiteford, 1990). The full benefits of such simulations, however, are only fully utilised when this approach is used to separately identify the different factors leading to changes in the levels of family income (or any other dependent variable) over time.

This paper is part of such a project estimating the determinants of income trends over the 1980s. The focus here is on the impact of changing participation, unemployment and part-time employment rates on the level and distribution of family incomes between the years 1981–82 and 1988-89.

Indeed, for all the applications mentioned above, the need to take account of labour market changes is of central importance. This is particularly so for Australia in the 1980s. This decade has seen several major changes in labour market conditions. From a level of 5.6 per cent in August 1981, the unemployment rate rose rapidly to 9.9 per cent in August 1983, followed by a slow decline to 5.7 per cent in 1989. Whilst overall participation rates also fell slightly during the 1982–83 recession, their growth since that time has been very strong, particularly for married women. In August 1983, 42 per cent of married women were in the labour force. By 1989 this had risen to 51 per cent. In association with this growth in married women's participation, a shift towards part-time employment has also occurred. In August 1980, 16 per cent of the employed were working part-time. By 1989 this had risen to 21 per cent.[2]

For studies concerned with the adjustment of household surveys in order to describe more current (or historical) distributions of family incomes, the strong relationship between labour market status and incomes means that these changes are important. Moreover this relationship between aggregate labour market trends and household incomes is of interest in its own right, irrespective of its use in providing updated income survey data sets. Falling unemployment, for example, would generally be expected to lead to increases in household disposable incomes and a reduction in income inequality. Such assumptions are a central rationale for the Accord between the Commonwealth Government and the Australian Council of Trade Unions. As Chapman, Dowrick and Junankar (1989) note,

> one of the factors which probably has so far prevented [the Accord's] collapse either through wage breakouts or through a change of political direction is a widespread belief that it has promoted social justice. (p. 40)

The goals of this paper are two-fold. First, to present a method of adjusting income surveys for labour market status changes which takes account of most of the key changes over the 1980s, but which is

---

1 Comments from Peter Whiteford and Peter Saunders, and the research assistance of Jenny Doyle and Toni Payne are gratefully acknowledged.

2 All figures are from the ABS Labour Force Survey, via dX Time Series Data service.

computationally straight-forward. Second, to apply this method to obtain some estimates of the distributional impact of labour market status changes between 1981–82 and 1988-89. In the next section, different simulation methods are summarised, and the *case adjustment* or re-weighting method introduced. Section 3 then examines some of the aggregation problems associated with the modelling of changes in the annual income distribution of Australian families. This is followed by a discussion of the calibration data used in this study. In Section 5 some results are presented describing the impact of labour market status changes on the family income distribution between 1981–82 and 1988–89. These results are summarised and evaluated in Section 6 and the limitations and potential extensions of the methodology discussed.

In considering the results presented in this paper, the scope of the analysis should always be borne in mind. This is to examine the impact of the changing distribution of the population across labour force states on family incomes. All other factors including wage rates, tax schedules, government benefits and other income sources should be considered as held constant at their 1985–86 levels. This, of course, is strongly counter-factual, but is necessary if we wish to understand the particular contribution of labour market changes to family incomes.

2. SIMULATION METHODS

There are two broad categories of methods which can be used to simulate household income data sets. The first, and potentially most powerful, has been termed *dynamic simulation*. This essentially involves taking a survey data set and simulating a longitudinal data set from it. Thus individuals in the sample might 'die' or be 'born', marry, become unemployed, get new jobs, have wage rises etc. For an overview of some overseas examples see Hellwig in this volume. Whilst invaluable for the modelling of policy changes which have interacting effects over long time periods (retirement income policy is an obvious application) for many applications both the goals and data requirements of such methods are too grand.

The more modest method employed in this paper has been termed *static simulation*. The goal of this method is to adjust survey data to simulate the (cross-sectional) income survey data set which might have been obtained had the survey been undertaken under different circumstances. This simulation is carried out by either adjusting the *variables* in the data set or by modifying the *case structure* via the case weights.

These two alternative adjustment methods can be illustrated via the example of an increase in the aggregate level of unemployment. One way to simulate such a change would be to take some of those persons recorded as being employed and 'sack them'. That is, adjust their recorded incomes to reflect the income they would be expected to receive if they were unemployed. This is the method used by Nolan (1986) who models the effect of a one percentage point increase in unemployment on the UK annual income distribution. He does this by examining the survey records of people who experienced both employment and unemployment during the year and calculating their weekly wages and unemployment benefit incomes. To simulate higher unemployment, he assumes that these same weekly rates hold, but that the person spends more weeks unemployed. Other incomes are assumed constant.

A problem with this method is that whilst it can be used to simulate an increase in the aggregate unemployment rate, it does assume that the number of persons experiencing *some* unemployment remains constant. This is generally not the case. One way of avoiding this restriction is to estimate the likely incomes of employed persons who become unemployed (rather than relying only on those cases with some unemployment). This is more likely to be a feasible option in Australia than in many other countries because of the relatively simple system of unemployment compensation. This leaves the problem of deciding which employed persons to 'sack'.

However, even more difficult is the modelling of the opposite situation, when unemployment falls. In this case one has to decide which unemployed persons will be given jobs, and, most importantly for income distribution analysis, what wages they will receive. Partly as a consequence of the limited information about such relationships, it is the alternative, case adjustment approach, which has been used more commonly in Australia (e.g. King, 1987a, 1987b; Bradbury, Doyle and Whiteford, 1990).

When sample surveys are conducted, a 'weight' is typically calculated to describe the number of families in the population that each family in the survey represents. These weights are derived from the inverse of the probability of selection, with some adjustment for factors such as differential non-response.[3] An increase in the unemployment rate can thus be simulated by increasing the weights of those cases experiencing unemployment, whilst decreasing the weights of those with no unemployment (to maintain the same total population). This adjustment implicitly assumes that the characteristics of the new unemployed will be the same as those already unemployed. Income distribution calculations which take account of these new weights will then reflect the increase in unemployment.

As described, it might seem that the variable and case adjustment methods are quite different and incompatible ways of simulating change. The variable adjustment method seems intuitively more reasonable, as it mimics real-life processes by imposing changes upon the units in the data file. Re-weighting is intuitively a more artificial adjustment.

However, if we view the survey data set as a representation of the characteristics of a population, rather than as the information on a collection of individuals, the differences between the two methods become less marked. They are both ways of modifying the data matrix to make it more closely correspond to what it would look like had the survey been conducted in different circumstances. The (weighted) univariate distribution of the variable which is adjusted (e.g. labour market status) will be the same in the new data set irrespective of which method is used. Indeed, bivariate distributions may also be identical in some circumstances. Thus, if the variable adjustment process gives those persons newly assumed to be unemployed, incomes with the same distribution as the incomes of those who were previously unemployed (and similarly for the employed), the two methods will provide identical estimates of the relationship between unemployment and incomes.

The methods will be more likely to differ, however, when higher order distributions are considered. Continuing this example, the variable adjustment method typically only changes the labour market status, wages, and income support incomes of those who become unemployed. Other variables are left unchanged at the values they held when the person was recorded as employed. The re-weighting process, on the other hand, has the other variables for the 'new' unemployed (represented by the increased weights) identical to the values of those who are already unemployed.

The key distinction between the two methods, therefore, lies in their treatment of incidental or un-modelled variables. The variable adjustment method implicitly assumes that they are defined independently of the change modelled and leaves them unchanged, whilst the weight adjustment method maintains their association with the adjustment variable. More precisely, variable adjustment holds the overall distribution of the incidental variable constant, whilst case adjustment holds constant the conditional distribution of the incidental variable within each category of the adjustment variable. If changes over time are being simulated, variable adjustment thus implies that the distribution of the incidental variable is independent of time, whilst the case adjustment method assumes conditional independence within each category of the adjustment variable. In the limit, as the two modelling methods are made more and more complicated in order to explicitly incorporate all these higher order changes, they will again produce the same multivariate distributions. But in practice, data limitations severely limit the degree of complexity of the adjustment process, and so these differences may be important.

The choice of the best simplifying assumption should thus depend upon the anticipated correlations between the criteria being modified and the other variables of interest (as well as upon practical considerations of data availability). For example, if a general rise in wages is to be modelled, it would be most appropriate to inflate the wage variable, rather than increase the weights on cases with higher wages. This is because other variables, such as the person's age, whilst correlated with wages at one point in time, are not correlated with aggregate economy-wide wage increases over time.

For the modelling of employment rates, on the other hand, there is a good case to be made for the use of re-weighting methods rather than variable adjustment. There is some evidence, for example, that the labour market statuses of husbands and wives may not be independent. In particular, wives of unemployed husbands are often observed to have a lower employment rate than wives of employed husbands (Scherer, 1978; Cass and Garde, 1983). Reasons advanced for this include an adherence to the role of husband as breadwinner and/or the effective marginal tax rates facing unemployment beneficiaries and their spouses. However, irrespective of the causal mechanism, it does indicate that

---

3 The surveys of the Australian Bureau of Statistics typically over-sample households in the smaller states in order to get stable state estimates. This state variation represents the vast bulk of the variation in the weights between families.

the not modelled 'other incomes' of the unemployed will tend to be different from those of the employed, and hence the independence assumption of the variable adjustment method will probably be inappropriate.

Whilst it is in principle possible to adjust variables to model this interaction between husband's employment status, wife's employment status and other incomes such as income support payments, this is very difficult. The best simplification is probably to assume that the inter-relationships between these variables for the 'new' unemployed are the same as for the 'old' unemployed (the re-weighting method), rather than assuming these other variables to remain constant (the simple variable adjustment method).

For this reason, together with the practical problems described above, this paper (and all other Australian research) uses the re-weighting method to adjust income distribution data to reflect changes in employment levels. Whilst this may imply that the 'new' unemployed will have the same demographic composition as those already unemployed in the base data, the adjustment in practice is carried out separately for different demographic groups, permitting the overall composition of the unemployed to vary.

Simple Re-weighting Methods

Case adjustment thus involves the increase or decrease of case weights in some *base* data set in order to reflect the changes in some other *calibration* data set. For the simple example above, the base data might be from an income survey, whilst the calibration data is the unemployment rate for different time periods. In the re-weighting results described in Section 5 of this paper, the base data is that from the unit record file of the ABS *1986 Income Distribution Survey* (IDS) whilst the calibration data consists of tables from the ABS *Labour Force Status and Other Characteristics of Families* (LFSOCF) surveys.

When the base and calibration data sets are of very similar definition and scope, it is appropriate to adjust the base data so that it directly replicates the calibration data for the new time period. Using the symbol + to denote summation over the relevant subscript, let,

w_{tij} represent the desired weight for the ith case in category j at time t,

w_{0ij} the corresponding weight in the original data,

f_{tj} the proportion in the adjusted data in category j at time t. ($= w_{t+j} / w_{t++}$),

f_{0j} the corresponding proportion in the base data ($f_{0+} = 1$),

x_{tj} the proportion in the calibration data in category j at time t ($x_{t+} = 1 \ \forall t$).

If the base and calibration data are of very similar scope (for example the Income Distribution Survey and the Labour Force Survey as used by King, 1987b) then it is desired that $f_{tj} = x_{tj}$ in all time periods. The simplest way to ensure this is to multiply each case weight by the ratio of desired to actual fractions. That is,

$$w_{tij} = w_{0ij} \, x_{tj} / f_{0j} \qquad (1)$$

By summing over this expression, it can easily be verified that this will maintain the same total number of cases ($w_{t++} = w_{0++}$) and that $f_{tj} = x_{tj}$ as required.

However, it is often the case that the calibration and base data are similar but not identical in scope and/or category definitions. In this case it is desired that *changes* in the calibration data are reflected in the adjusted base data. The simplest way to formulate this, whilst ensuring adding up, is to assume that changes in the proportion of the population group in a particular labour market state (in the calibration data) should produce the same change in the proportion of the adjusted data in that state. This implies that,

$$f_{tj} - f_{0j} = x_{tj} - x_{0j}$$

or

$$f_{tj} = f_{0j} + x_{tj} - x_{0j} \qquad (2)$$

Since, f_{0j}, x_{tj} and x_{0j} are all proportions, $f_{t+} = 1$. Given this formulation for the desired proportion, the weights are again multiplied by the ratio of desired to original proportions,

$$w_{tij} = w_{0ij} \, f_{tj} / f_{0j} \qquad (3)$$

Similarly, it can be verified that the total number of cases is not altered by the re-weighting process. Note that when the proportions in the base and calibration data are identical, equation (3) reduces to equation (1). But because the base and calibration data used in this paper do not entirely correspond in scope or definition of labour market status, the method described by equations (2) and (3) has been used.

However, one limitation of this method is that it can produce negative weights. From equations (2) and (3) it can be seen that negative weights will be defined if the decrease in the proportion in a category in the calibration data is greater than the proportion in the base data. That is, if,

$$-(x_{tj} - x_{0j}) > f_{0j}$$

For the results reported in Section 5, this situation occurred for only two categories, where the head was unemployed and the wife working part-time, and where the wife was unemployed and the head was working part-time (there were very few cases in these cells in the 1986 Income Distribution Survey). To prevent negative weights being assigned, these categories were combined with the corresponding unemployed + full-time employed categories.

Multiple Vector Re-weighting

Such simple weight adjustment methods, however, can only be used when there is a single dimension of calibration categories, or when there are more dimensions but these are orthogonal to one another. Where reasonably detailed calibration data are available, single vector adjustments may be sufficient for most purposes. A single vector can, of course, contain many categories, and in the example described in Section 5 a vector of 56 family type/labour market status categories is used.

At the expense of additional computational burden, however, there are methods which can be used when there is more than one calibration vector. For example, it might be desired to calibrate according to both labour force survey data, and Department of Social Security data on the number of pensioners and beneficiaries in different categories. Atkinson, Gomulka and Sutherland (1988) discuss these methods in some detail, and it is useful to summarise some of their discussion here.

In general, in order to have a unique solution satisfying all the calibration vectors, additional constraints are required. These constraints usually take the form of requiring the new weights to be in some sense 'close' to the original weights whilst satisfying the calibration data constraints. The paper by Atkinson *et al.* discusses a number of feasible distance measures, including the information measure proposed by Merz (see also Merz, 1986)

$$d = \Sigma_{ij}\, w_{tij} \log(w_{tij}/w_{0ij})$$

An intuitive grasp of the significance of this constraint can be gained by noting that in the two by two case, (i.e. two binary calibration variables), the minimisation of this distance measure is equivalent to a process which adjusts the data to satisfy the marginal constraints whilst holding the odds-ratios of the two variables constant.

In the absence of data on any changes in the relationships between these two variables, this seems to be a quite plausible assumption.[4] The main limitations of these methods stem from their complexity. Minimisation of this distance measure whilst satisfying all the required constraints requires the solution of a non-linear system of equations using iterative methods[5] (see Merz, 1986 and Bungers and Quinke, 1986). For a solution to be found, it is necessary that the adjustment variables be linearly independent of one another—otherwise inconsistent adjustments will be attempted. Whilst independence in the total population can usually be assumed, with a large number of constraints sampling zeros in the cells of the cross-tabulation may require some categories to be aggregated.

Probably more common in practice is the case where near-singularities in the adjustment matrix exist. An example might be the simultaneous adjustment of unemployment and unemployment beneficiary numbers. If most unemployed are beneficiaries, and most beneficiaries are unemployed, an increase in the number of unemployed, but not in the number of beneficiaries, will mean large increases in the weights of those few cases unemployed but not receiving benefits. Whilst in one sense a correct representation of changes, careful attention will need to be paid to the results obtained to see that they

---

4 If the cross-tabulation of the two constraints were known it could be re-formed into a single vector of constraints.

5 If more than two calibration vectors are used.

do not depend too much upon other special characteristics of the non-beneficiary unemployed (e.g. their age) which may not have been explicitly adjusted.

In this example at least, the near-singularity in the adjustment matrix reflected the population distribution. In general, however, if many adjustments are made, such near-singularities can occur simply through sampling zeros in the data. In general, care will need to be taken to ensure that results do not depend unduly upon un-modelled characteristics of cases assigned unusually large weights. Since estimates of the impact of policy changes typically involve information on these other variables which have not been explicitly adjusted, it is important to clearly identify the sensitivity of results to highly weighted observations.

Such considerations have led Sutherland to conclude that,

> It may be that the dimensions controlled for in grossing-up should be kept general and broadly defined and that specific problems are best dealt with in an ad hoc way that does not have repercussions elsewhere. (1989, p. 15)

There are thus two reasons why multi-vector re-weighting methods have not been used here. The first is simply the computational complexity of simultaneously adjusting for a number of control totals. The second is the desire for a relatively simple method where the results are reasonably transparent outcomes of the inputs. The compromise between simplicity and transparency can never be finally satisfied, and discussion of the results below suggests some areas where further complexity may be justified.

3. MODELLING THE DETERMINANTS OF ANNUAL FAMILY INCOMES

In the simulation of the impact of changing labour market conditions upon family incomes, there are two key aggregation problems. Most Australian labour market data record labour market status as a characteristic of individuals at a given point in time. Whilst labour market incomes accrue to individuals, consumption, and by inference economic welfare, is usually a function of some wider income sharing unit such as the household or family. In addition, consumption levels are usually a function of incomes over a period of time in which individuals labour market status may vary. Both these aggregation dimensions are usually taken into account in studies of income distribution and inequality.

This paper follows the convention of much recent Australian research by analysing the income distribution across *income units* as defined by the Australian Bureau of Statistics. Income units comprise either married (including de facto) couples, couples with dependents, sole parents with dependents, and single adults. Non-dependent children are thus defined as single adult income units even if they are still living with their parents.[6] In this paper, the term 'family' is used synonymously with this income unit concept. Whilst a very narrow definition of the family, this definition has the advantage of being similar to that used in the tax and social security systems in Australia.

Even with this narrow definition, information on the joint distribution of husbands' and wives' statuses is required. This is particularly important for the 1980s where there were major changes in the employment patterns of both women and men. Unfortunately, the most commonly used labour force calibration data, that from the monthly labour force survey, did not permit such an adjustment until recently (and then not in the degree of detail used here).

In using this data, previous research in Australia has only adjusted *person* weights on the basis of changes in the labour force data, and then averaged these to obtain income unit weights.[7] Unfortunately in periods when the labour force patterns of both husbands and wives are changing, this can lead to an underestimate of the impact on incomes. This can be illustrated with a simple example. Suppose there were only two married couple income units in the file, each representing 100 income units in the population with initial weights as follows,

---

6 A dependent is defined as someone who is 'aged under 15 years, or aged 15 to 20 years and a full-time student, who has a parent/guardian in the income unit and is neither a spouse nor parent of anyone in the income unit' (ABS Cat. No. 6545.0).

7 This is the method used by Bradbury, Doyle and Whiteford (1990). It would appear that a similar method was used by King (1987b). The simple numerical example is adapted from Bradbury, Doyle and Whiteford, Appendix A.

WH	WS	$\bar{W}$	EH	ES
100	100	100	e	n
100	100	100	e	e

Where WH and WS are the head and spouse person weights, $\bar{W}$ is the income unit weight (calculated as the average of WH and WS), and EH and ES are the employment statuses of the head and spouse (e=employed, n=not employed). The employment rate for heads is 100 per cent and that for spouses 50 per cent. Suppose that the calibration data suggests that spouses should now have an employment rate of 75 per cent (with the heads' rate unchanged). The spouse weights would then be adjusted to represent these changes. Since the income unit weight is calculated as the average of head and spouse weights it is adjusted as follows,

WH	WS	$\bar{W}$	EH	ES
100	50	75	e	n
100	150	125	e	e

If we now calculate the head and spouse's employment rates from the income unit weight, the head's employment rate is still 100 per cent but that of the spouse is only 62.5 per cent (=125/200) rather than the 75 per cent required. In this case, the income unit weight would ensure the appropriate estimates of employment rates (and hence incomes) only if it were defined to be equal to the spouse weight. This result, of course, is special, and rests upon the assumption that all heads are employed. The point of this example, however, is to illustrate the result that calculating income unit weights on the basis of averaged person weights may lead to an underestimate of the actual impact of labour market status changes.

The other area where calibration data typically falls short of the detail of the base data is in the aggregation of incomes over time. The results presented in this paper focus on (fiscal year) annual incomes, both because this is the longest time period for which base data is available, but also because this analysis is part of a larger project examining a wider range of influences on family disposable incomes. For this larger project, concordance with the income tax year is a major consideration, and so fiscal year estimates of labour market incomes are desirable.

Using annual rather than current incomes can change the measured impact of unemployment on the income distribution quite significantly. Persons unemployed part-year will have income levels between those employed full-year and those fully unemployed. The impact on the distribution of income of a given number of person-weeks of unemployment will thus vary depending upon whether this unemployment is concentrated on a few full-year unemployed individuals, or spread more thinly across many persons with short unemployment spells. The only calibration data available which describes labour market statuses over a long period of time is that from the ABS *Labour Force Experience* (LFE) survey. This survey, however, does not permit aggregation across income units. Moreover, it refers to calendar years (ending February) and is usually not available until about seven months after the end of the year to which it refers.

4. CALIBRATION DATA

In the face of such limitations on the calibration data, and also because of the desire to keep the method reasonably simple, it has been necessary to focus the goals of the adjustment method more narrowly. Accordingly, the calibration data for this exercise has been chosen to enable adequate estimation of the following labour market changes:

- To identify the labour market states of not in the labour force, unemployed, part-time employed and full-time employed. As noted in the introduction, significant changes in all these states have occurred over the 1980s.
- To identify the combined labour market status of husbands and wives.
- To separately identify labour market trends for families with and without dependents. This is because of the importance of issues of child poverty in current policy debates, and the possibility that labour market trends may be significantly different for wives with and without dependents.

The only data available in Australia which permits calibration according to these characteristics is that from the ABS *Labour Force Status and Other Characteristics of Families* (LFSOCF) survey conducted in June or July of each year.[8] This provides information on the labour market status of persons in different family statuses, as well as providing a cross-classification of the labour market status of husbands and wives. Table 1 shows the distribution of income units across the different family classifications available from the survey in June 1986. The table also includes the corresponding distribution calculated from the *1986 Income Distribution Survey* (IDS) carried out in September-December 1986 (the base data) as well as the mean after tax income of each family type in 1985–86.

The most common income unit types are married couples, adult children and single person households. Together, these income unit types comprised 80.6 per cent of income units in June 1986. Persons in households of unrelated adults comprised another 8.7 per cent, followed by sole parents (4.4%), other family heads (e.g. sole parents with only non-dependent children, one of a pair of siblings living together) (3.4%) and other relatives (e.g. parents of the family head) (2.9%).

These patterns are broadly replicated in the 1986 IDS, with the differences probably stemming from the different collection methodologies employed. The most important difference is the narrower coverage of the LFSOCF survey, which covered only 93 per cent of the population (see footnote 8), compared to around 98 per cent for the 1986 IDS. This is why the IDS reports half a million more income units than does the LFSOCF survey. The larger proportion of single person households in the IDS results from the inclusion of persons in non-private dwellings in this survey—most of whom would be classed as single person income units.

Over the period 1981 to 1989 the fastest growing income unit types have been single person households and persons in group households, followed by sole parents (though their proportions have fluctuated significantly). The income unit type with the greatest proportionate decline has been couples with dependents, decreasing from 28.8 per cent in 1981 to 25.2 per cent in 1989.[9]

Whilst a general updating procedure would want to adjust for these changes in the income unit composition of the Australian population, the results presented in this paper only adjust for changes in labour market status *within* each of these income unit types. This has been done to allow attention to be focussed upon the impact of labour market changes on family incomes.[10] Obviously, for results considering the income distribution of a single family type (e.g. couples with children) the conclusions will be identical irrespective of whether a family type adjustment is undertaken also.

Whilst the LFSOCF survey thus provides a good disaggregation of labour force status by income unit type, its use does preclude anything other than a very simple linking in terms of annual labour force status. The method used involves two steps. The first step is the calculation of indices which reflect the changes in annual labour force status for each of the different income unit types. The labour market states separately identifiable in the LFSOCF data are, not in the labour force, unemployed, employed part-time and employed full-time. For couples, the 16 cell matrices of the distribution

---

8 This survey suffers from a number of breaks in consistency. The most important occurred between the 1982 and 1983 surveys, where the scope of the survey was narrowed to exclude persons enumerated in non-private dwellings, enumerated as visitors to private dwellings, or in private dwellings where it was not possible to collect information on all usual residents. The 1983 and subsequent surveys thus have a coverage of only around 93 per cent of the civilian population aged 15 and over. It has been assumed that this change has not affected the labour force distribution of each family type (though for future analysis involving family weighting, adjustments have been made to the family type distribution).

Other changes include: The definition of dependent was changed in 1986 to include full-time students aged 21-24. The category 'other families with dependents' was re-defined as 'sole parents' in 1989 (98% of 'other families with dependents' were defined as sole parents). In Table 1 the June 1986 proportions have been adjusted to conform to the definition of dependent used in the IDS survey. This involved 0.5 per cent of couples with dependents in the June 1986 survey being classified as couples without dependents. This adjustment was made on the basis of calculations from the 1986 IDS using both definitions of dependent. Also 4.5 per cent of persons classed as full-time students aged 15-24 were assumed to be aged 21-24 and hence classed as adult children of the family head rather than as dependents.

9 These calculations adjust for the break in consistency between 1982 and 1983 (see footnote 8).

10 Incorporation of family composition changes would complicate the presentation of results because the decrease in married couple families has led to a decrease in average incomes per income unit, but little change in incomes per adult.

Table 1 The Distribution of Income Unit Types in 1986

Income Unit Type	*Percentage Distribution* June 1986	*Percentage Distribution* September-December 1986	*Mean Net Income 1985–86 ($000)*
Married Couple Income Units,			
without dependents	23.0	23.7	*18.7*
with dependents	26.1	25.9	*23.4*
Single Adult Income Units Living with Other Family Members			
Sole Parents	4.4	4.2	*8.6*
Other Family Heads	3.4	2.8	*9.3*
Adult Children of Family Head	17.5	16.8	*8.5*
Other Relatives of Family Head	2.9	2.5	*8.1*
Single Adult Income Units Not Living with Family Members			
Single Person Households	14.0	16.2	*10.9*
Group Households	8.7	7.9	*10.1*
TOTAL	100.0	100.0	*16.3*
Number ('000)	7,175.9	7,633.8	

Sources: ABS *Labour Force Status and Other Characteristics of Families, Australia,* June 1986 (Cat. No. 6224.0), adjusted as per footnote 8 and ABS *1986 Income Distribution Survey,* Unit Record File.

across each of these states for the husband and wife are used. Simple financial year averages have been calculated as the averages of the June or July end-year months.

These basic calibration data are shown in Tables 2 and 3. For ease of interpretation, the distribution across each of the four labour market states are described in terms of labour force participation, unemployment and full-time employment rates. For couples, the overall husbands' rates are given, plus the rates for wives with husbands in each of the labour market states—giving the 15 parameters required to specify their combined distribution across the 16 cell cross-tabulation. These tables reflect the broad trends summarised in the introduction. Unemployment rates increased with the 1982–83 recession (though in fiscal year averages peaking in 1983–84), and then gradually declined. Participation rates, particularly for married women, rose steadily, whilst the proportion employed full-time generally fell slightly.

The 1986 IDS, however, records the numbers of weeks spent in each of the four labour market states, rather than the labour market states at the beginning and end of the year. (Labour market states are also recorded for September-December 1986, but these are not used here). The link between this annual labour force status and the averaged current status available from the LFSOCF survey is made chiefly in terms of the labour force state in which persons spent the most weeks during 1985–86. However, in view of the volatility of unemployment and some of the patterns of unemployment concentration observed, persons experiencing unemployment are treated differently.

As was noted earlier, the ABS does have one survey which permits analysis of labour market spells over a twelve month period. This *Labour Force Experience* (LFE) survey (Catalogue No. 6206.0) can be used to gain an insight into the way in which the distribution of unemployment experience during the year varies with the overall state of the labour market. Nolan (1986), in summarising US and UK research finds that, in general, when the overall unemployment rate is relatively high,

- the number experiencing some unemployment during a 12 month period is relatively high and
- those experiencing unemployment during the year are relatively more concentrated in the higher duration categories.

Table 2 Labour Force Status, Married Couple Income Units, 1981-82 to 1988-89

	1981-82	1982-83	1983-84	1984-85	1985-86	***1985-86 IDS***	1986-87	1987-88	1988-89
Couples without dependents									
Husband									
Participation rate	.628	.622	.619	.612	.608	***.627***	.612	.610	.610
Unemployment rate	.027	.044	.053	.048	.044	***.042***	.041	.041	.036
Full-time	.942	.942	.938	.938	.941	***.923***	.939	.934	.929
Wife with									
Husband full-time									
Participation rate	.594	.605	.614	.622	.643	***.702***	.665	.683	.699
Unemployment rate	.030	.035	.033	.029	.025	***.026***	.026	.029	.027
Full-time rate	.704	.719	.711	.695	.691	***.733***	.682	.685	.700
Husband part-time									
Participation rate	.426	.435	.464	.456	.448	***.555***	.485	.520	.504
Unemployment rate	.025	.029	.038	.041	.046	***.033***	.050	.040	.042
Full-time rate	.483	.452	.474	.468	.441	***.352***	.440	.432	.413
Husband unemployed									
Participation rate	.394	.420	.420	.387	.379	***.278***	.451	.454	.416
Unemployment rate	.322	.345	.351	.355	.402	***.494***	.434	.397	.345
Full-time rate	.812	.718	.722	.690	.607	***.771***	.652	.650	.650
Husband nlf									
Participation rate	.060	.057	.060	.063	.063	***.065***	.061	.062	.064
Unemployment rate	.030	.036	.031	.026	.032	***.067***	.052	.057	.059
Full-time rate	.610	.604	.602	.632	.591	***.522***	.556	.581	.557
Couples with dependents									
Husband									
Participation rate	.957	.955	.954	.952	.950	***.949***	.947	.942	.942
Unemployment rate	.028	.047	.055	.047	.046	***.044***	.048	.047	.042
Full-time rate	.978	.976	.974	.974	.975	***.977***	.973	.972	.974
Wife with									
Husband full-time									
Participation rate	.474	.481	.488	.511	.549	***.564***	.579	.595	.608
Unemployment rate	.049	.061	.061	.054	.055	***.041***	.053	.051	.045
Full-time rate	.432	.435	.433	.428	.421	***.447***	.417	.412	.413
Husband part-time									
Participation rate	.493	.505	.534	.555	.555	***.589***	.572	.561	.587
Unemployment rate	.079	.076	.078	.096	.072	***.013***	.070	.080	.052
Full-time rate	.353	.345	.380	.390	.399	***.487***	.452	.467	.452
Husband unemployed									
Participation rate	.277	.274	.276	.257	.251	***.252***	.263	.285	.319
Unemployment rate	.370	.460	.538	.551	.557	***.486***	.519	.452	.472
Full-time rate	.552	.470	.444	.536	.511	***.527***	.493	.532	.496
Husband nlf									
Participation rate	.203	.211	.236	.252	.275	***.242***	.283	.277	.290
Unemployment rate	.096	.132	.137	.129	.109	***.093***	.108	.106	.095
Full-time rate	.553	.545	.605	.570	.549	***.641***	.594	.623	.598

Table 3 Labour Force Status, Single Adult Income Units, 1981-82 to 1988-89

	Year								
	1981-82	1982-83	1983-84	1984-85	1985-86	*1985-86 IDS*	1986-87	1987-88	1988-89
Participation Rates									
Sole Parent	.473	.449	.445	.452	.473	*.403*	.486	.498	.536
Other Family Heads	.382	.383	.377	.380	.383	*.444*	.387	.411	.435
Adult Child	.913	.911	.912	.909	.909	*.822*	.910	.910	.911
Other Relative	.435	.449	.423	.416	.440	*.443*	.452	.455	.450
Single Person	.443	.445	.440	.443	.444	*.451*	.442	.441	.434
Group Household	.799	.819	.841	.854	.856	*.811*	.854	.852	.856
Unemployment Rates									
Sole Parent	.095	.141	.160	.132	.127	*.133*	.129	.136	.124
Other Family Heads	.057	.078	.100	.088	.086	*.129*	.093	.095	.082
Adult Child	.108	.150	.164	.143	.128	*.127*	.128	.124	.100
Other Relative	.138	.188	.198	.180	.171	*.190*	.157	.155	.141
Single Person	.035	.058	.073	.070	.066	*.086*	.064	.072	.069
Group Household	.099	.123	.128	.115	.104	*.083*	.103	.096	.078
Full-time Rates									
Sole Parent	.693	.696	.672	.656	.667	*.752*	.669	.664	.637
Other Family Heads	.825	.834	.822	.821	.833	*.852*	.807	.797	.807
Adult Child	.932	.922	.917	.921	.917	*.887*	.907	.904	.907
Other Relative	.913	.908	.894	.909	.913	*.939*	.899	.899	.906
Single Person	.891	.887	.889	.892	.895	*.894*	.895	.889	.881
Group Household	.889	.889	.885	.883	.885	*.898*	.881	.880	.881

This general relationship also holds in Australia. In 1980, for example, when the average unemployment rate as measured by the Labour Force Survey was 6 per cent, 16 per cent of those in the labour force at some time during the year spent some time looking for work.[11] By 1983, unemployment had risen to 10 per cent, with 20 per cent of the labour force experiencing some job search. The fall in unemployment rates over subsequent years was also generally matched by a fall in the proportion of the labour force looking for work.

Similarly, unemployment concentration is also positively correlated with the overall unemployment level. In 1980, 29 per cent of those who looked for work at some time during the year were looking for at least half the year, and 12 per cent were unemployed for the full year. By 1983, this had risen to 40 per cent and 18 per cent respectively.

If the detailed pattern of unemployment spells over the year cannot be modelled, it would at least be desirable to reflect these general tendencies. The facts that unemployment experience generally increases and that unemployment experience becomes more concentrated as unemployment rates rise, prompts the question of whether the increase in unemployment experience can be explained simply by the increase in long duration unemployment. Or to put this question the other way round—does the proportion of the labour force experiencing short durations of unemployment remain relatively constant as the overall unemployment rate changes?

In fact the LFE survey does suggest that this is generally the case. For the years from 1980 to 1988, the proportion of those in the labour force at some time during the year who experienced between 1 and 26 weeks unemployment remained relatively constant at around 11-13 per cent. More

[11] For most years the LFE survey refers to the twelve months during the year ending in February. Here, the data from the surveys is described in terms of the calendar year which it most represents. It should be noted that the definitions of unemployment in the LFE survey is not the same as in the Labour Force Survey. In the latter, unemployment is defined in terms of availability for work and active job search. The Labour Force Experience Survey simply asks people how many weeks during the year they were looking for work (whilst not working).

importantly, this proportion shows no association with the overall unemployment rate. This fact is used here to provide a simple link between overall unemployment rates and unemployment experience which will reflect these general concentration tendencies.

This is done by classifying people who spent 26 weeks or more looking for work in 1985–86 as unemployed, with the remainder of the population classified as not in the labour force, employed part-time, or employed full-time depending upon in which of these three states they spent most weeks. This 'predominant labour market status' thus forms the basis for the reweighting calculations. This ensures that a rise in unemployment at the expense of full-time unemployment, for example, produces an increase in the proportion of the population experiencing 26 weeks or more unemployment, and a decrease in the proportion of the population otherwise employed full-time for most of the year. The weights of those persons who did not experience half year unemployment, and whose main (other) labour market state was either not in the labour force or part-time employment, remain unadjusted. Because the proportionate reduction of the full-time employed will only be small (they comprise a much larger population than the unemployed) the proportion of the labour force with less than half year unemployment will remain roughly constant. Hence, both the proportion of the population experiencing unemployment and the concentration of unemployment among those experiencing it will rise. This of course, is only a very rough method of incorporating annual income aggregation into the model, but without much more detailed (and timely) calibration data, it seems to be the best practical solution.

The base labour market distributions thus estimated from the 1986 IDS for each income unit type are also shown in Tables 2 and 3 (in bold italic type). Whilst these rates are generally similar to those from the LFSOCF surveys, there are many cells where significant divergences exist. The main reason stems from the linkage between the annual data and the current data. This will not necessarily give the same estimates of labour force status distribution as in the LFSOCF data but is designed simply to reflect the general patterns expected with labour market changes. There are also other reasons why we would expect divergences. First, as was noted earlier, the scope of the two surveys is not entirely identical. Second, the calibration data is only the average of the end months of the year. Third, the IDS has a significantly smaller sample size than the LFSOCF survey, and so some of the estimates in the table are subject to significant sample error. Finally, the labour force measures of the two surveys are different, with the IDS employing a retrospective methodology, and the LFSOCF survey collecting information about current labour market status.

Comparison with the Labour Force Survey Data

However the more important comparison is with the participation and unemployment rates predicted by the re-weighting process (based on the LFSOCF data and the classification method described above) and the more commonly used Labour Force Survey (LFS) estimates of average annual participation and unemployment. Because of the way in which the calibration data is defined, it would be surprising if either the adjusted LFSOCF data or the re-weighted IDS data directly reflected that from the LFS. What *is* desired, however, is that *changes* in the proportions in the different labour market states are mirrored.

An evaluation of the correspondence between the different data sources is provided in Table 4. This table shows the aggregate fiscal year participation (overall and just for married women) and unemployment rates calculated using five different methods. In order to compare changes, the table also shows these different rates relative to their value in 1983–84 (the year of peak unemployment).[12] The first calculation method is simply the average of the monthly participation and unemployment rates available from the Labour Force Survey (LFS). This is followed by the end-year averages from the LFSOCF surveys. Because these data cover only income unit heads and spouses, rather than the whole population aged 15 and over, overall participation rates are higher than in the LFS data—though trends are quite well reflected. Similarly, the fact that the LFSOCF is only carried out during June or July (months of low seasonal unemployment) means that the unemployment rate is consistently lower than the 12 month LFS average. Whilst the participation changes between 1981–82 and 1983–84 are reflected reasonably consistently, the LFSOCF data estimates the drop in unemployment to 1988–89 to be 0.3 percentage points less than estimated by the LFS.

12 These differences are calculated from data with a higher degree of numerical precision than included in the table, and hence do not always accord with the differences calculated from the table itself.

Table 4 Comparison with Monthly Labour Force Survey Averages

	Year							
	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
Participation Rates (%)								
Monthly LFS data	61.0	60.6	60.5	60.5	61.4	62.0	62.2	62.6
Difference from 1983–84	*0.5*	*0.1*	*0.0*	*0.0*	*0.9*	*1.5*	*1.7*	*2.1*
LFSOCF data	63.5	63.4	63.6	63.7	64.3	65.1	65.3	65.7
Difference from 1983–84	*–0.1*	*–0.2*	*0.0*	*0.1*	*0.7*	*1.6*	*1.7*	*2.2*
LFSOCF data (fixed dem.)	63.1	63.1	63.2	63.5	64.3	65.1	65.5	66.0
Difference from 1983–84	*–0.1*	*–0.1*	*0.0*	*0.3*	*1.1*	*1.9*	*2.3*	*2.8*
Simulated IDS data								
Predominant status	62.4	62.4	62.5	62.8	63.6	64.4	64.8	65.2
Difference from 1983–84	*–0.1*	*–0.1*	*0.0*	*0.3*	*1.1*	*1.9*	*2.2*	*2.7*
Weekly status	62.9	62.8	62.9	63.2	63.9	64.6	64.9	65.3
Difference from 1983–84	*0.0*	*–0.1*	*0.0*	*0.3*	*1.0*	*1.7*	*2.0*	*2.4*
Married Women's Participation Rates (%)								
Monthly LFS data	42.2	42.3	42.4	43.6	46.0	48.3	49.2	50.3
Difference from 1983–84	*–0.2*	*–0.1*	*0.0*	*1.2*	*3.6*	*5.9*	*6.8*	*8.0*
LFSOCF data	42.6	42.7	43.2	44.4	46.6	48.7	49.9	51.0
Difference from 1983–84	*–0.7*	*–0.5*	*0.0*	*1.2*	*3.3*	*5.5*	*6.7*	*7.8*
LFSOCF data (fixed dem.)	42.4	42.6	43.1	44.3	46.6	48.8	50.0	51.2
Difference from 1983–84	*–0.7*	*–0.5*	*0.0*	*1.2*	*3.5*	*5.7*	*6.9*	*8.1*
Simulated IDS data								
Predominant status	45.1	45.2	45.8	47.0	49.2	51.4	52.6	53.8
Difference from 1983–84	*-0.7*	*-0.5*	*0.0*	*1.2*	*3.4*	*5.6*	*6.8*	*8.1*
Weekly status	46.0	46.0	46.5	47.5	49.5	51.4	52.5	53.6
Difference from 1983–84	*–0.5*	*–0.5*	*0.0*	*1.1*	*3.0*	*5.0*	*6.0*	*7.1*
Unemployment Rates (%)								
Monthly LFS data	6.2	9.0	9.6	8.6	7.9	8.3	7.8	6.6
Difference from 1983–84	*–3.4*	*–0.6*	*0.0*	*–1.0*	*–1.7*	*–1.3*	*–1.9*	*–3.0*
LFSOCF data	5.4	7.8	8.7	7.6	7.1	7.1	7.0	6.0
Difference from 1983–84	*–3.3*	*–0.9*	*0.0*	*–1.1*	*–1.6*	*–1.6*	*–1.7*	*–2.7*
LFSOCF data (fixed dem.)	5.5	7.8	8.7	7.6	7.1	7.1	7.0	6.1
Difference from 1983–84	*–3.2*	*–0.9*	*0.0*	*–1.0*	*–1.5*	*–1.6*	*–1.7*	*–2.6*
Simulated IDS data								
Predominant status	5.0	7.3	8.2	7.1	6.7	6.6	6.5	5.6
Difference from 1983–84	*–3.2*	*–0.9*	*0.0*	*–1.0*	*–1.5*	*–1.5*	*–1.6*	*–2.5*
Weekly status	5.9	7.8	8.5	7.7	7.3	7.2	7.1	6.4
Difference from 1983–84	*–2.6*	*–0.7*	*0.0*	*–0.8*	*–1.2*	*–1.3*	*–1.4*	–2.1

As was noted earlier, in order to simplify the interpretation of results, the simulation in this paper takes no account of changes in the demographic composition of income units—adjusting only for labour market changes within each family type. The family type composition of the population is thus assumed constant. The third set of participation and unemployment estimates are thus calculated on a comparable basis, assuming the family type composition fixed at the 1985–86 distribution. Whilst this makes only a small difference to the calculation of unemployment levels, it has a significant impact upon participation rates with changing demographic composition decreasing aggregate participation by 0.6 percentage points between 1983–84 and 1988–89 (0.6=2.8-2.2). This is largely a reflection of the ageing of the population over the period.[13]

Finally two alternative estimates of participation and unemployment rates are calculated from the re-weighted IDS data. The first is based on the individual's predominant status during 1985–86. This was the variable used for the weight adjustment calculation. As the identity in equation (2) implies,

---

13 Though the family type categories are not explicitly disaggregated by age, the proportion of aged in different family types varies significantly.

the changes in participation and unemployment rates reflect those of the LFSOCF estimates with fixed demographic characteristics.[14]

Alternative estimates of average annual status can also be calculated from the number of weeks spent in different labour market states. These average rates are defined as,

$$P = \Sigma_i L_i / 52N, \text{ and}$$

$$U = \Sigma_i U_i / \Sigma_i L_i$$

where L_i is the number of weeks in the labour force of person i, N is the total number of persons and U_i is the number of weeks person i was unemployed. Although the definitions of unemployment differ between the LFS and IDS, this latter estimate is probably the one which we would expect to most closely reflect the changes over the period in aggregate labour force status trends. Unfortunately, the correspondence is less than might be desired.

In particular, unemployment changes seem to be under-estimated compared to the LFS data. Between 1981–82 and 1983–84 unemployment rose by 3.4 percentage points in the LFS data, but only 2.6 percentage points for the average weekly status measure with the re-weighted data. Similarly, between 1983–84 and 1988–89 the LFS measure of unemployment decreased by 3.0 percentage points, whilst the simulated weekly status variable decreased by only 2.1 percentage points. As is evident from examining the last column of the table, this difference is the result of several different steps in the data calculation process.

First the LFSOCF data do not reflect the full extent of employment changes between 1983–84 and 1988–89. This is mainly because the averaging of June/July months misses out on the peak in unemployment in the middle of the 1983–84 year. Second, the different demographic composition of the IDS means that the change in unemployment suffers a further slight attenuation. Finally, the weekly status unemployment rate shows less change than the predominant status rate. Given the very simple link made between annual and current status a divergence of this magnitude should not be too surprising. By linking changes in unemployment to the weights of all those persons unemployed more than half year, the method implicitly assumes that the relative distribution of unemployment experience within the more than half-year group has stayed constant. However there is some evidence that decreasing unemployment has decreased the proportion of full-year unemployed slightly faster than the proportion of more than half year unemployed.[15]

Thus, in terms of estimating the impact of unemployment falls since 1983–84, the estimates presented in the next section should be considered as lower bounds. The weekly status variable indicates an increase in unemployment between 1981–82 and 1983–84 of only 2.6 percentage points compared to 3.4 percentage points in the labour force survey. Hence one might surmise that a more accurate estimate of the income changes due to the increase in unemployment over this period would be some 30 per cent higher than that shown in the next section. For the period after 1983–84 the discrepancy is somewhat larger (around 40 per cent). Similarly, the changes in participation rates are also underestimated, with the increase in married women's participation since 1983–84 about 1 percentage point less in the simulated data than in the LFS. In this case however, this is a much smaller proportion of the actual change of around 7-8 per cent, and hence of less significance in the interpretation of results.

However whilst historical trends may be underestimated, there is no particular reason to expect the *relationship* between the rate changes summarised in Table 4 and the income changes described in the next section to be biased.

Finally, it worth emphasising those dimensions of population change that are not accounted for in the LFSOCF calibration data. Probably the main limitation is the lack of disaggregation by age. It is

---

14 The differences are not entirely reflected because of the slightly different family type compositions of the calibration and base data (see Table 1).

15 Data from the LFE survey, whilst not on a financial year basis, indicates that during 1983 and 1984 the proportion of persons looking for work for more than half year, who were looking for work for the full year was about 44-45 per cent. Over the period 1985 to 1988 this proportion has been slightly lower, ranging between 42 and 43 per cent. It is also interesting to note that the largest divergences in unemployment rates in Table 4 occur where the unemployment rate was changing most rapidly (i.e. between 1981-82 and 1982-83 and after 1986-87).

assumed that the labour status trends affect all persons within the income unit type equally, whereas there will clearly be differences by age. The change in labour force participation of wives without dependents, for example, has almost all occurred among wives of working age—rather than among such wives generally. This problem is partly dealt with by the cross-tabulation by husbands' work force status which functions as a rough proxy for age.

One problem which is not so easily addressed however, is the impact of changing *husbands'* participation. As is apparent from Table 2, the labour force participation of husbands without dependents fell slightly over the period. This fall, however, was due primarily to the increase in the proportion of this group above retirement age. If attention is focussed on families of work force age (as in the next section) the re-weighting will incorrectly increase the weights on those husbands not in the labour force, producing lower income estimates. Because of their high levels of wage income, this has a small but significant impact upon the overall estimates of income changes.

As a consequence, an obvious extension of the approach used here would be to calibrate on the basis of different family type/age categories. Unfortunately the LFSOCF data does not permit this to be done for married couple families, though some such adjustment would be possible for single adult income units (though not for the full four category labour force status categorisation). At this stage separate adjustment by age group has not been undertaken, though where appropriate, some suggestions of *ad hoc* changes are made.

The solution to all these problems may will turn out to be the use of multi-vector re-weighting. One possibility to be examined in future research is to combine the calibration data from this study with that from the LFS contained in Bradbury, Doyle and Whiteford (1990).

5. RESULTS

Whilst the limitations of the calibration data and the linkage process are important, the most fundamental limitations on what can be achieved with a microsimulation model stem from the base data—in this case the ABS *1986 Income Distribution Survey* (IDS). It is the representativeness and accuracy of this data which provides the ultimate limitations on the estimates that can be made. For the examination of the relationship between labour market trends and family income levels and distributions, the definition and quality of the income data available in the base data set is clearly of central importance.

The main ambiguity springs from the lack of concordance between incomes as measured by household surveys, and the economic concepts of income and welfare. When use is of made of the term 'inequality', for example, it is usually inequality of economic welfare that is under consideration, rather than simply inequality in incomes. These are not always directly related. On the other hand, income aggregates themselves are important, for example, to describe the expected change in aggregate wages or social transfers as a result of a given change in unemployment. In this case, income component aggregates covering as wide a population as possible are desired.

For estimation of the impact of labour market changes on economic inequality, however, it is often more appropriate to narrow the population to exclude those cases for which incomes are anticipated to be a poor indicator of welfare. For example, the ABS in its publications of annual income data from the IDS always excludes cases for whom incomes are considered atypical. The most important categories of cases excluded are persons attending school for part of the year, females changing marital status, and persons overseas during the year (see ABS Catalogue No. 6540.0).[16] In addition, following the precedent set by the Commission of Inquiry into Poverty (Henderson, 1975), Australian researchers using income data to describe poverty typically exclude the self-employed, as well as young single person income units living with their parents.

The self-employed have been excluded because of both the conceptual and the practical difficulties in measuring their incomes (see Covick, 1986). Whilst it can by no means be assumed that the economic incomes of all self-employed are understated by the measures used in income surveys, it is clear that the link between income and welfare is much weaker for the self-employed than for income units primarily reliant upon other income sources. The exclusion of young single person income units living

16 As well, income units which are incomplete (e.g. one member could not be contacted) are excluded from ABS income unit tables.

with their parents, on the other hand, stems less from measurement problems than from ambiguities in the definition of the income sharing unit. Because of consumption sharing between income units in such families, their economic welfare is likely to be only weakly related to their income level.

Because of such considerations, the results in this paper are presented for two main populations. For the description of the aggregate trends of different income components, the widest possible population available from the survey is used in order to fully capture the overall trends.[17] For the analysis of the effects of labour market changes upon economic inequality, a narrower population is used, excluding income units with atypical annual incomes (the standard ABS exclusion), working in their own business during the year, or single people aged under 21 living with their parent(s).[18] Of the total of 7.6 million (weighted) income units represented on the file, the exclusion of those with atypical incomes removes 7.9 per cent, the exclusion of the self-employed a further 16.3 per cent and the exclusion of youth a further 5.8 per cent. This narrower population thus represents 5.3 million income units, or 70 per cent of the total population. In addition, because the issues of labour market change are not very relevant to the retired population, most of the tables focus only on income units where the head is aged under 60 years (excluding another 19 per cent of income units). This most narrow population definition is described below as the 'restricted' population.

The IDS recorded a large amount of information about income from different components, as well as the personal income tax paid by each person. For the analysis of inequality the key variable in this paper is the combined after-tax income of the head and spouse (where present) of the income unit. [19] This is the income concept most likely to be closely linked to economic welfare. The population and income measure thus chosen for the analysis of inequality is thus one where we might expect, given adequate data quality, for the income measure to be reasonably closely related to welfare. At a broader level, probably the main weakness with this measure is its ignoring of leisure. This is an important caveat, particularly when the impact of rising labour force participation rates on the income distribution is considered.

Most importantly, the counter-factual nature of the results presented here need to be remembered. The key assumption of the adjustments by labour force status category is that incomes within each labour force status remain constant (the conditional independence assumption). For example, in estimating the distributional impact of increasing unemployment, no allowance is made for the fact that the newly unemployed may come predominantly from the lower end of the wage distribution. Rather, the distribution of wages among the employed is assumed constant within each income unit type. Whilst this is probably a close approximation, such independence assumptions have not been explicitly tested.

Whilst the primary goal of this paper is to present results showing the overall result of labour market status changes on the income distribution, it is clearly possible to also carry out this analysis describing only a sub-set of the changes. In Table 5 the estimated aggregate impact of unemployment rate changes alone are shown. The first line of the table shows the weekly status unemployment rate estimated from the re-weighted data generated for each year. This differs slightly from that of Table 4 because of the different treatment of the unemployment rates of couples.[20] In the second panel of the table, corresponding unemployment rates for the restricted population are are also presented. These are higher partly because of the exclusion of part-year school students and persons overseas part-year (who would be less likely to have more than 25 weeks of unemployment), but mainly due to the exclusion of the self-employed. Few of these people had experienced unemployment during the year, and so their exclusion reduces the denominator of the unemployment rate. This is only partly offset by the exclusion of young persons living with their parents (who have a high unemployment rate). These exclusions also explain the higher volatility of the unemployment rate in the restricted population.

---

17 The scope of the IDS covered approximately 98 per cent of the population, only excluding persons in institutions or in remote areas. Persons overseas for the whole year are excluded from all tables.

18 The age cut-off of 21 is obviously rather arbitrary, but follows that of Henderson (1975).

19 The income of dependents was excluded primarily because the labour market adjustment model could only adjust income unit weights on the basis of head and spouse labour market status. Thus any change in the labour market participation of dependent students is not accounted for. For cases with recorded income tax greater than 50 per cent of gross income, and with gross incomes less than $50,000, or where income tax was not recorded, income tax was calculated on the basis of 1985–86 incomes.

20 In Table 5 the weights of income units are adjusted first by the husbands' unemployment status and then by then by the wives' unemployment status, rather than simultaneously as is done for the full reweighting in Table 4.

Table 5 Impact of Unemployment Changes on Average Incomes, 1981-82 to 1988-89

	Year							
	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
Full Population								
Unemployment Rate[a] (%)	5.8	7.8	8.5	7.7	7.3	7.3	7.2	6.4
Average Incomes								
Wages/Salaries ($000 pa)	15.06	14.74	14.60	14.74	14.80	14.80	14.81	14.93
(Index 1983-84=100)	*103.2*	*100.9*	*100.0*	*100.9*	*101.4*	*101.4*	*101.4*	*102.3*
Govt Transfers ($000 pa)	1.93	2.02	2.06	2.02	2.00	2.00	2.00	1.97
(Index 1983-84=100)	*94.1*	*98.2*	*100.0*	*98.2*	*97.5*	*97.5*	*97.4*	*95.9*
Gross Incomes ($000 pa)	20.88	20.57	20.44	20.57	20.63	20.63	20.65	20.76
(Index 1983-84=100)	*102.2*	*100.6*	*100.0*	*100.7*	*100.9*	*101.0*	*101.0*	*101.6*
Net Incomes ($000 pa)	16.55	16.33	16.24	16.34	16.38	16.38	16.39	16.47
(Index 1983-84=100)	*101.9*	*100.6*	*100.0*	*100.6*	*100.8*	*100.9*	*100.9*	*101.4*
Restricted Population								
Unemployment Rate[a] (%)	6.6	8.9	9.9	8.9	8.8	8.4	8.3	7.5
Net Incomes ($000 pa)	18.07	17.80	17.68	17.80	17.85	17.85	17.86	17.95
(Index 1983-84=100)	*102.2*	*100.7*	*100.0*	*100.7*	*100.9*	*100.9*	*101.0*	*101.5*

Notes: (a) Unemployment rates calculated on the same basis as the 'weekly status' rates in Table 4.

Whilst the income changes in the restricted population may be of more interest for some purposes, it must be remembered that it is the full population rather than the restricted population against which the labour market changes have been calibrated. It must remain an untested assumption that the changes in labour market status for a given family type in the full population also apply to any sub-population which is chosen. Such assumptions are implicit in all simulation analyses that attempt to draw conclusions about variables other than those explicitly incorporated in the calibration data.

The implications of these unemployment rate changes for aggregate income components are also shown in Table 5. The remainder of this table shows the estimates of changes in aggregate incomes on the assumption that everything except unemployment rates remained at 1985-86 levels. All incomes should thus be interpreted as if in 1985-86 dollars. Changes in average wages arise not via a direct variation in wages, but by a change in the number of income units receiving wages.

It is interesting to compare the estimates of wage changes in Table 5 with those from a simple BOTE[21] calculation. It is easy to show that if people are assumed to be either employed, unemployed or not in the labour force, and participation rates and average wages of employed persons remain constant, an increase in the unemployment rate from U_0 to U_1 will lead to a decrease in average wage income (over the whole population) of,

$$100\left[\,1-(1\text{-}U_1)/(1\text{-}U_0)\,\right]$$

percent.[22] Between 1981–82 and 1983–84 the simulated unemployment rates rose from 5.8 to 8.5 per cent, and so this expression implies a resulting wage fall of 3.0 per cent (using 1983–84 as the base year). The actual estimate from Table 5 is slightly higher at 3.2 per cent.

Following the drop in aggregate wage incomes with the recession, aggregate wages are estimated to have risen by 2.3 per cent between 1983–84 and 1988–89. Fluctuations in disposable incomes however, should be expected to be less severe, being offset by income transfers and the progressive nature of the income tax system. As Table 5 indicates, government transfers are highly counter-cyclical, leading to a change in gross incomes of only 2.2 per cent between 1981-82 and 1983-84. (To

21 Back Of The Envelope-are not acronyms wonderful?

22 This can be re-arranged as $100U_1 - 100U_0 + 100U_0\ 100[U_0(U_1\text{-}U_0)/(1\text{-}U_0)]$. When unemployment rates and the change in unemployment rates are small, the last term approaches zero, and the percentage point change in unemployment rates becomes an approximate estimate of the per cent change in wages.

Table 6 Impact of Increases in Wives' Participation Rates on Average Incomes[a], 1981-82 to 1988-89

	Year							
	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
	(Index 1981-82=100)							
Full Population								
Wages/Salaries	100.0	100.2	100.3	100.6	101.1	101.5	101.9	102.1
Govt Transfers	100.0	99.9	99.9	99.8	99.6	99.4	99.3	99.2
Gross Incomes	100.0	100.2	100.3	100.6	101.1	101.6	102.0	102.2
Net Incomes	100.0	100.2	100.3	100.6	101.1	101.6	102.0	102.2
Restricted Population (Married Couples Only)								
Net Incomes	100.0	100.3	100.5	101.0	101.9	102.7	103.3	103.7

Note: (a) Describes the effect of changing participation rates of wives with husbands employed only.

concord with the indices in the table, percentage changes are expressed with the 1983-84 level in the denominator). Net (after tax) incomes show even less variation. This variation in incomes is increased somewhat for the restricted population, because of the removal of the aged and self-employed income units whose incomes are less subject to fluctuations with changing unemployment levels (though the self-employed may be influenced indirectly through changes in aggregate demand).

Again the counter-factual nature of the exercise needs to be remembered. Amongst other things, income tax levels are assumed constant at 1985–86 levels. But if the higher expenditure levels associated with income support for additional unemployed are not offset by increased government deficits, taxes will have to rise. This would imply a greater cyclical variation in household disposable incomes than shown here.

It is interesting to compare these aggregate impacts of unemployment rates with those due to the increased participation rate of married women. Both of these factors have been responsible for the large growth in employment since the 1982–83 recession—though they have very different distributional impacts. The overall impact of this participation rate change on aggregate incomes is shown in Table 6. In order to proxy the fact that the main change in unemployment levels has been for wives of working age only, this table only describes the impact of the increase in participation rates of wives with employed husbands. Whilst participation rates for other wives have also increased, these changes have been significantly smaller than for wives of employed husbands (see Table 2).

The first part of the table shows the impact of changing wives' participation on the average incomes of all families (including those with no wives). Whilst participation increases between 1981–82 and 1983–84 led to only a small increase in incomes, the impact since that year has been considerable, with the increasing participation of wives leading to a wages growth of around 1.8 per cent between 1983–84 and 1988–89. This can be compared with the estimate in Table 5 of a wages growth of 2.3 per cent due to decreasing unemployment (though as noted earlier this is probably an underestimate).

The relatively large size of the impact of married women's participation may seem surprising, given the significant falls in unemployment over this period. However, of the new jobs created since 1983–84, *Labour Force Survey* statistics indicate that 39 per cent have gone to married women. Whilst married women may have lower wages than average workers, this is offset by the fact that many of the unemployed in 1983–84 were younger workers who also had relatively low wages.

In terms of net incomes, the influence of wives earnings is even more marked, with increases since 1983–84 of around 1.9 per cent compared to the estimate of 1.4 per cent due to unemployment decreases. If we take account of the probable underestimation of the unemployment increases, this implies that the increasing participation of married women has had a similar impact on net incomes as has falling unemployment since 1983–84. This larger impact on net incomes reflects the fact that transfer payments are often available to unemployed workers, but rarely to secondary non-participants. These average income increases are of course much higher when attention is restricted in the bottom

Table 7 Impact of Labour Force Status Changes on Average Incomes, 1981–82 to 1988–89

	1981-82	1982-83	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89
				Year (1983-84=100)				
Full Population								
Mean Family Incomes								
Wages/Salaries	103.4	101.1	100.0	100.8	101.6	101.9	102.0	103.1
Govt Transfers	93.2	97.9	100.0	98.6	97.6	97.3	97.3	95.6
Gross Incomes	102.1	100.6	100.0	100.7	101.5	101.9	102.0	102.9
Disposable Incomes	101.8	100.5	100.0	100.7	101.4	101.8	102.0	102.8
Restricted Population								
Mean Family Incomes								
Wages/Salaries	103.7	101.1	100.0	101.0	101.9	102.1	102.2	103.6
Govt Transfers	87.3	96.2	100.0	96.6	94.7	94.8	94.9	91.1
Gross Incomes	102.5	100.7	100.0	100.8	101.4	101.7	101.8	102.8
Net Incomes	102.1	100.6	100.0	100.7	101.3	101.6	101.8	102.7

panel of Table 6 to couples of working age (and not self-employed). The disposable incomes of such couples are estimated to have risen by 3.7 per cent over the period since 1981–82 simply as a result of the increase in married women's participation.

The slight reduction in transfer payments as a result of increased married women's participation is due to two factors. First, female labour market participants tend not to have children, and hence lower levels of family allowances on average. An increase in their proportion in the population thus lowers overall transfer payments. Second, transfer receipt is often associated with female non-participation (e.g. non-participating wives of unemployed husbands). Although the adjustment in Table 6 is only done for wives with husbands mainly employed, this association may occur through part-year transfer receipt. This second example is an example of where the re-weighting is probably inappropriate, as the increase in female labour force participation probably does not apply to this group. However the bias introduced is only small.

Once again the counter-factual nature of the calculations needs to be stressed. In particular the re-weighting method implicitly assumes that the 'new' women participants have the same characteristics as women in the labour force in the base data. To the extent to which this assumption is incorrect, the results will also be wrong. Moreover, despite the definition of the 'restricted population' as one where incomes are assumed to be relatively adequate measures of well-being, the exclusion of benefits from 'leisure' or home production has important implications for the interpretation of the results. If the increase in wives' participation has been at the expense of reduced home production (or leisure) then the welfare gains of families will be less than those implied from the changes in incomes alone (and possibly even zero). The resolution of this issue is not possible here but it should be remembered in the interpretation of results.

Whilst this description of the separate effects on incomes of unemployment and participation rate changes is certainly of interest, it is perhaps the combined outcome of labour market changes which is of the most interest to income support policies. The remainder of this section thus describes the results from the full re-weighting taking into account changes in participation, unemployment and full-time rates for single adult income units, and the changes in the 16 way labour force classification for couples. The aggregate results of this calculation are summarised in Table 7.

To a large extent the pattern shown in Table 7 reflects the estimates of the effects of unemployment and participation changes shown in the earlier tables. Wage and salary incomes show the cyclical impact of Table 5 combined with the steady increase in Table 6 Government transfers are dominated by the cyclical impact of changes in unemployment, whilst gross and disposable incomes broadly follow the pattern set by wages.

However the relationship between the three tables is not always additive. Between 1983–84 and 1988–89, for example, Table 5 estimates that overall disposable incomes increased by 1.4 per cent as a result of falling unemployment, whilst Table 6 shows an increase of 1.9 per cent due to increasing

Table 8 Impact of Labour Force Status Changes on Average Incomes of Selected Family Types, 1981–82, 1983–84 and 1988–89

Income Unit Type	*Mean Disposable Incomes* *Full Population* 1983-84 level ($000)	% increase 1981-82 to 1983-84	1983-84 to 1988-89	*Restricted Population* 1983-84 level ($000)	% increase 1981-82 to 1983-84	1983-84 to 1988-89
Couple (no dependents)	20.7	–1.3	2.0	24.1	–1.1	4.1
Couple with dependents	24.1	–1.4	3.6	23.1	–1.9	3.8
Sole parent	9.8	–4.9	6.7	9.9	–4.5	6.1
Single Person	9.9	–2.4	2.3	12.0	–2.7	2.3
TOTAL	16.2	–1.8	2.8	17.6	–2.1	2.7

married women's participation. The overall impact of changes in labour market status in Table 7 is an increase of 2.8 per cent—less than the sum of the other two changes. This reflects a number of factors. First, the increase in part-time employment is also taken into account in Table 7 and this will lead to a reduction in incomes. Second, these latter estimates take into account interactions in the labour market status between husbands and wives. Finally, the estimates of Table 7 take into account changing participation rates for groups other than wives. As was noted in the previous section, participation rates for both husbands with and without dependents have fallen slightly over the period (Table 2).

As before, the restricted population of working age, non self-employed, non child income units shows a greater sensitivity to labour market changes. Between 1981–82 and 1983–84 wages and salaries are simulated to have dropped by 3.7 per cent, while government transfers rose by 12.7 per cent, and disposable incomes fell by 2.1 per cent (all percentages expressed with 1983-84 values in the denominator). By 1988–89 net incomes had actually risen above their 1981–82 values due to the combination of falling unemployment and rising women's participation.

Table 8 shows the estimated changes in average incomes of four different family types in both the full and restricted populations. Discussion for the remainder of this section will focus on the restricted population, but it can be seen that most of the changes observed there are reflected in the full population also. For both the sub-periods, couples with dependents have fared worse than those without dependents. Their drop in income as a result of the recession was greater, whilst their subsequent income recovery was weaker.[23] The main reasons for this differ between periods. The poor result for couples with children in the first period (1981-82 to 1983-84) reflects the larger increase in unemployment among husbands and (particularly) wives with dependents, whilst their slower rate of recovery reflected the slower fall in unemployment for husbands with dependents and the greater impact of increasing participation for wives without dependents. (Although the rates of participation increase are similar for wives with and without dependents, because the latter tend to work full-time, a change in their participation pattern has a greater impact upon incomes).

For sole parents, the decrease in incomes with the recession, and the corresponding increase in the subsequent recovery, was particularly significant. As well as their unemployment increasing with the recession they experienced a significant drop in both participation and full-time rates in the early 1980s. This was followed by a reduction in unemployment and steadily increasing participation after 1984 (see Table 3). Over the whole period the incomes of sole parents are estimated to have increased by about 1.6 per cent as a result of their employment status changes.

23 The difference between couples with and without dependents is probably slightly greater than indicated in Table 8 due to the lack of a separate age calibration in the data. The fall in participation of husbands without dependents (0.9 percentage points in each of the periods 1981-82 to 1983-84, and 1983-84 to 1988-89) was largely a result of their changing age distribution, but the lack of an age distinction in the calibration data means that the model inappropriately applies this fall in participation to husbands of working age as well as to all husbands. It is estimated that this has led to the income increases for couples without dependents in the restricted population being underestimated by about 0.2 percentage points in each period.

Whilst labour market status changes for these three family types have thus led to average incomes in 1988–89 being higher than in 1981–82, this is not the case for single adult income units. For this group participation increases have not been sufficient to offset the only partial recovery in unemployment from the 1982–83 recession.

Moreover, for all income unit types the average trend hides a wide variation in the experience of families with differing characteristics. In particular, the effect of increasing wives' participation has a very different effect upon the income distribution than a decrease in unemployment. If families are ranked by family incomes, those with participating wives will be found in the top sections of the income distribution, whereas those with husband or wife unemployed are to be found at the bottom end. Alternately, if families are ranked by full income, including wives home production (a simple proxy for which might be to rank on husbands' income alone), couples with working wives are spread reasonably evenly across the distribution.[24]

Whilst space does not permit a separate distributional analysis of the effects of participation and unemployment on the income distribution the outcomes of these different factors for the income distribution are certainly of importance. However the fact that families have different needs and income earning potentials makes interpretation of the overall distribution of incomes difficult. To control for such variations, researchers typically control for needs with the use of equivalence scales, to reduce all incomes to 'adult equivalents'. However, rather than face the choice of the appropriate scale to use, this paper adopts an alternative approach of examining the income distribution of each family type separately. If inequality within each of the family types has been reduced we can conclude that overall inequality must have also reduced, irrespective of the true equivalence scale (Atkinson and Bourguignon, 1987).[25]

Table 9 shows te changes in the average net income levels of different quantiles in each of four different family types. For the reasons mentioned earlier, this is done for the restricted population only. The first column of the table shows mean incomes for each of the income quintiles in 1983–84, the year of peak unemployment. The bottom quintile has been further disaggregated because it is at the lower end of the income distribution that employment changes would be expected to have the greatest impact. The second and third columns then show the estimated percentage change in incomes between 1981–82 and 1983–84, and between 1983–84 and 1988–89. Once again, to permit comparisons between the two periods, all percentage changes have been calculated with the 1983–84 values in the denominator. Gini coefficients are also shown for each of the three years.[26]

For couples without dependents, the regressive nature of the recession is very evident with the bottom quintile facing much higher average income falls than the middle and top quintiles. Interestingly, the change in income was greatest for the second decile, rather than the first. This reflects the greater homogeneity of the first decile of the income distribution, where most couples had neither head nor spouse employed during the year for any of the years since 1981–82. (Of course these deciles need not contain the same people in each period). Also note that the very top quintile also experienced a decrease in income with the recession. This does not reflect the fact that some of the income units in this quintile became unemployed (because the quintile ranking is calculated separately for each year), but rather is a result of the general 'expansion' of the number of cases at the bottom of the income distribution as a result of increased unemployment-shifting all the quintile boundaries downwards. [27] This then leads to a fall in the average incomes of the top quintiles. This fall, however, was much less than the average, and so the income shares of the top three quintiles increased during the recession.

The recovery of employment after 1983–84 reversed some of these changes, though the situation of the lowest decile did not improve nearly as much as might be expected given its income fall during the recession. This is a result of the concentration of families with both members not employed at the bottom end of the income distribution. As Table 2 indicates, labour force participation rates for wives

---

24 With the exception of the bottom two deciles where the positive association between husbands' and wives employment leads to a lower level of wives participation.

25 Atkinson and Bourguignon also prove a stronger result where this conclusion holds even when this condition does not apply to all family types.

26 Though income shares are not shown in this table it possible to calculate them from the numbers provided. Thus the 1981-82 income share of the bottom decile of couples without dependents is 0.1x8.5x1.054/(24.1x1.011)=3.7 per cent.

27 The re-weighting process does not re-rank cases in the file (*variables* are held constant).

Table 9 **Trends in Mean Quantile Incomes as a Result of Labour Force Status Changes, by Income Unit Type (Restricted Population).**

	Mean Income 1983–84	Percentage Change 1981–82 to 1983–84	1983–84 to 1988–89
Couples without Dependents			
Bottom Decile	8.5	–5.4	2.5
Second Decile	12.9	–6.7	6.1
Second Quintile	18.0	–2.7	6.7
Middle Quintile	23.7	–0.8	6.4
Fourth Quintile	29.2	–0.1	3.3
Top Quintile	38.9	–0.1	2.1
TOTAL	*24.1*	*–1.1*	*4.1*
Gini Coefficients	1981–82	1983–84	1988–89
	0.228	0.236	0.229
Couples with Dependents			
Bottom Decile	10.0	–11.4	3.5
Second Decile	14.6	–5.9	3.8
Second Quintile	18.3	–2.6	4.5
Middle Quintile	22.2	–1.3	4.6
Fourth Quintile	26.5	–0.8	4.2
Top Quintile	36.3	–0.6	2.6
TOTAL	*23.1*	*–1.9*	*3.8*
Gini Coefficients	1981–82	1983–84	1988–89
	0.197	0.207	0.204
Sole Parents			
Bottom Decile	3.1	–2.3	7.4
Second Decile	5.4	–1.2	3.3
Second Quintile	6.8	–2.4	3.5
Middle Quintile	8.3	–3.4	5.6
Fourth Quintile	11.2	–8.6	11.0
Top Quintile	19.0	–4.4	4.8
TOTAL	*9.9*	*–4.5*	*6.1*
Gini Coefficients	1981-82	1983–84	1988–89
	0.296	0.290	0.293
Single Persons			
Bottom Decile	3.1	–2.9	4.1
Second Decile	5.2	–4.1	4.3
Second Quintile	7.9	–8.1	7.8
Middle Quintile	11.9	–3.1	2.7
Fourth Quintile	15.1	–1.7	1.2
Top Quintile	20.9	–0.9	0.5
TOTAL	*12.0*	*–2.7*	*2.3*
Gini Coefficients	1981–82	1983–84	1988–89
	0.277	0.286	0.276

with husbands unemployed or out of the labour force did not increase significantly over the period, and hence these families did not participate in the general increase in income associated with increasing wives' participation. It is possible that the lack of age distinction in the calibration data means that this is an under-estimate of participation changes for wives of non-employed husbands, but the similar pattern of slow income recovery for wives with dependents suggests that this bias is only small.

The income gain of the second quintile of couples without dependents was, however, particularly large. This reflects the strong impact of the increase in wives' participation (in addition to the fall in unemployment). Because couples heterogeneous in wives' labour market status predominate near the middle of the income distribution, their average income level is particularly sensitive to increased wives' participation. Families at the top of the income distribution were predominantly two earner families in all periods, and so gain little with increasing participation. However, if couples were ranked by full income including wives' home production (or ranked by husbands' income), quite different conclusions might be obtained. As mentioned above, under this ranking, participating wives are spread more evenly across the income distribution, and so an increase in participation (following the same patterns as existing participation) would have less impact upon the income distribution. (Though the disadvantageous result for the bottom decile families would still hold).

A similar story holds for couples with dependents. One feature standing out however, is the 11 per cent drop in the income of the bottom decile between 1981–82 and 1983–84. The change in the gini coefficient between these two years is also greater than for couples without dependents. This reflects the fact that low income couples with dependents are more likely to be unemployed, than couples without dependents, who may be older (though with heads' below 60 years in Table 9) and hence not in the labour force. Again, low income groups recovered some of their income share during the recovery, but again, participation rate changes tended to leave the bottom decile behind.

Sole parents, however, stand out from the other family types as having quite a different pattern of income distribution changes. It is the fourth quintile of sole parents who have experienced the greatest fluctuations in incomes as a result of labour force status changes. It should be noted, though, that sole parents' incomes are generally low, with the average income of the fourth quintile roughly equal to that of the bottom quintile of couples with dependents. Those sole parents with lower incomes are more likely to be not attached to the labour force, and so insulated from labour market changes.

Finally, for single person income units, the effects of unemployment changes over the period predominate, with the results in Table 9 broadly similar to results (not shown) where only unemployment changes are modelled (though with some effect of increased participation for the lower income groups after 1983–84). The largest fluctuations in income levels (and shares) are again for the second quintile because of non-labour force participants at lower income levels.

In general, these results are what might be expected, with unemployment increases being generally regressive. The effect of participation changes, however, is perhaps more surprising. When ranked by combined income as in Table 9 increasing wives participation leads to strong income gains for middle income families, at the expense of those in the lower and upper ends of the income distribution. However if families were ranked by full income, the impact of increasing wives' participation would be more even—apart from the bottom quintile.

Whilst some of the limitations of the calibration data have been already pointed out, the particular patterns of income variation observed for the bottom deciles should also remind us of the importance of the quality of the base data for distributional analyses. It was noted above that the lack of responsiveness of the incomes of the bottom decile to unemployment changes reflected the fact that many were out of the labour force. This, in fact, is only part of the story. Though the restricted population used here was chosen to exclude cases where income was likely to be inappropriately measured, or was not an adequate measure of welfare, some puzzling features remain. For example, of the bottom decile of single adult income units (with incomes below $4,800 in 1985-86), 8.7 per cent were predominantly full-time employed during 1985–86. Similarly, 15.6 per cent of couples in the bottom decile (with incomes below $12,300) had husbands predominantly employed full-time. If such cases were excluded the sensitivity of the income level of the bottom decile to labour market changes would be significantly increased.

More generally, any 'noise' in the data will tend to reduce the associations observed between predictive factors and the distribution of income. This is yet another reason for considering these estimates as lower bounds for the impact of labour market status changes on the income distribution.

6. SUMMARY, EVALUATION AND CONCLUSIONS

How does one evaluate the accuracy of microsimulation results? There are two key problems that need to be addressed. First, the models may be mis-specified—with some important change omitted. Secondly, even relatively simple exercises such as that described in this paper involve many steps of data entry, programming and presentation (and indeed interpretation) of results—each of which is subject to potential errors. In the social sciences, resources are scarce and questions many, and so replication is rarely a feasible solution to the problem of error control. The method that most researchers follow can probably be summed up in the following (only slightly tongue in cheek) dictum: *If it's interesting, then it's probably wrong. If it is not interesting then it doesn't matter if it's wrong.*

The key point we should get from this 'rule' is that it is most productive to evaluate microsimulation results in the context of their substantive application. This, at least, has been the goal of this paper, where a model of labour market change has been used to address questions about the impact of such changes on the income distribution. Some of the conclusions above *are* interesting, and in this section some attempt is made to verify their correctness. In many respects, the ideal method is replication—comparison with alternative estimates of the same phenomena. Usually, however, this is not a feasible option and so other more restrictive methods must be used. Just as with macroeconomic models, one way of verifying conclusions is with simple BOTE calculations. The other, to use a favourite phrase of a colleague, is to see if the results are 'plausible'.

The substantive conclusions of the paper can be summarised as follows. The simulated increase in unemployment of 2.6 percentage points between 1981-82 and 1983–84 led to a change in average wage income across the whole population of around 3.2 percentage points. The counter-cyclical nature of government transfers and taxes meant that this translated into a decrease of around 1.9 per cent in family disposable incomes. This decrease is larger for the restricted population of work force age, non-self employed, non-children.

The simulated estimate of unemployment change over this period, however, is probably an underestimate, and in any event the period covered does not cover the full extent of the labour market changes associated with the 1982–83 recession (for example, average unemployment in 1980–81 was lower than in 1981–82). As an estimate of the relationship between the simulated changes in unemployment and incomes, however, it is probably reasonably adequate, according well with a simple BOTE calculation. Like all results in this paper, the estimate assumes that all other factors, wage rates, demographic distributions, taxes and transfers etc, remain constant at their 1985–86 levels.

Taking these biases into account, we can state that, for the post 1983–84 period, the increase in wives' participation has been of almost as much importance as unemployment decreases in increasing total family disposable incomes. The average incomes of couples of work force age (and not self-employed) are estimated to have increased by around 3.7 per cent since 1981–82 as the participation rates of wives rose.

This increase in participation means that, when the overall effects of labour market change are estimated, average incomes in 1988–89 are now higher than in 1981–82, despite the less than full recovery in unemployment rates. However quite different patterns are discernible by family type and income level. Assuming other variables held constant, labour market status changes led to sole parents experiencing the largest fluctuations in incomes—though their increasing participation since the recession means that their incomes are now higher than in 1981–82. On the other hand, labour market changes for single persons over the decade have tended to decrease their average incomes. Couples (of working age) without dependents have generally fared better than couples with dependents over the period. This is because of both the slower fall of unemployment rates of husbands with dependents, and also the larger impact of participation increases for wives without dependents (who are more likely to work full, rather than part time).

Most of these conclusions could have been inferred from data on labour market trends and average income levels. However the microsimulation approach to this question becomes more useful when estimates of the distributional outcome of these aggregate changes are desired. One of the possible ways of presenting this data has been done in Table 9.

Apart from couples with dependents, the income level of the very bottom of the income distribution was little affected by changes in labour market status. This reflects the concentration of non-participants in the bottom decile, together with the fact that at no time over the period considered here was unemployment totally eradicated. In all periods therefore, there were enough unemployed (together with the non-participants) to comprise a large proportion of the bottom decile. Apart from this, the income share and level of the lower income quintile significantly decreased with the onset of the recession, producing significant increases in the Gini coefficients.

For the period 1983–84 to 1988–89 these changes due to unemployment were combined with those due to the impact of increasing participation—primarily of married women. With couples ranked by the combined disposable income of head and spouse (rather than by, say, heads' income) the increase in wives' participation mainly increased the incomes of middle and lower income families. Those at the very bottom of the income distribution again missed out due to the association between husbands' and wives' employment status. For couples and sole parents, family incomes are significantly more equal in 1988–89 than they were in 1981–82 (though whether this would apply to measures of full income is an open question).

Although replication is a method rarely practised by social scientists, there is one opportunity available to us to check the robustness of the method described in this paper. In *SPRC Discussion Paper No. 16*, Bradbury, Doyle and Whiteford (1990, hereafter DP16) used an alternative static ageing methodology to examine similar questions to those asked here. This paper estimated the overall impact of labour market, demographic, economic and policy changes on the distribution of family incomes between 1982–83 and 1989–90. Although the results presented in the present paper have only considered labour market changes, it is a straight-forward extension to calculate weight variables which take into account the changing distribution of the population across demographic groups. These can be merged with the disposable income variables calculated for DP16 to obtain estimates comparable to those presented in that earlier paper. In DP16 it was assumed that employment rates in 1989–90 would be the same as in 1988–89. Hence, results using the 1988–89 weights calculated in the present paper can be directly compared. This is done in Table 10 which shows the percentage increase in real average incomes for different family types, together with the percentage increase in selected percentiles of the income distribution.

In DP16 re-weighting was carried out on the basis of changes in the employment rates (i.e. employed/population) of different age sex groups. The standard results were calculated using the average of the new individual weights to calculate the person weights (where there was more than one person in the income unit). However, as was noted in Section 3, in periods where heads and spouses have different employment rate trends, this may lead to an underestimate of income unit weight changes. Since the main employment change for couples was in wives' participation, in DP16 results were also calculated using the spouse weights as weights for the income unit. Both sets of estimates (for couples) are shown in the table, with the spouse weighted estimates always giving larger estimates of income increases.

For the most part, the estimates are quite similar, though there are some interesting exceptions. The largest divergence for increases in average incomes is for single persons aged under 25. DP16 estimated no increase in real incomes, whereas the weights from the method used in this paper estimate a 2.4 per cent increase. This divergence probably reflects a limitation in the weighting method of DP16. In that paper, changes in the employment rate were adjusted for all individuals aged 15 and over. However young single persons who are income unit heads rather than dependents are more likely to be participants in the labour market (i.e. students under 21 are classed as dependents). Hence their employment rate change since 1981–82 (mainly caused by falling unemployment) was greater than that for all young persons. This pattern is largely captured by the weighting method of this paper, as the calibration data refers to income unit heads and spouses only. In this case, most single person income unit heads aged under 25 would be classed in the family type 'adult children of the family head'.

Similarly, the larger income increases for sole parents, particularly those at the bottom end of the income distribution, reflects their more precise identification in the calibration data. In DP16 sole parent employment rates were assumed to simply follow those of non married women. However, as was noted in the previous section, the fluctuations in sole parents incomes with the recession was particularly notable. These revised estimates of income increases for sole parents should thus not be interpreted as implying higher incomes in 1989–90, but rather as reflecting lower incomes than estimated in DP16 for 1982–83.

Table 10 Percentage Change in Mean Real Disposable Incomes and Income Percentiles, 1982–83 to 1989–90

Family type	*Mean*	*Percentiles* 10	25	50	75	90	99
Single person							
Less than 25	**2.4**	8.5	4.9	**2.5**	2.7	0.7	-3.8
(DP16 estimate)	**(0.0)**	(2.4)	(-0.6)	**(0.5)**	(1.1)	(-0.3)	(-3.9)
25 to 64	**-0.1**	6.3	4.7	**1.9**	-2.9	-4.1	3.0
(DP16 estimate)	**(0.1)**	(4.1)	(4.0)	**(2.3)**	(-2.9)	(-3.7)	(3.0)
65 and over	**2.8**	3.9	4.2	**3.9**	3.7	1.4	-11.5
(DP16 estimate)	**(2.8)**	(3.7)	(3.9)	**(3.7)**	(3.3)	(1.4)	(1.5)
Couple, without children							
Head 65 and over	**2.1**	3.9	3.9	**4.1**	-0.2	-1.0	0.6
(DP16 estimate)	**(2.5,3.3)**	(3.9)	(3.9)	**(4.2,4.3)**	(1.6,2.5)	(-1.0,0.2)	(0.6)
Head less than 65	**1.0**	3.6	-1.4	**2.5**	1.2	-1.1	9.6
(DP16 estimate)	**(1.3,4.1)**	(4.8,7.5)	(0.5,5.4)	**(1.6,6.5)**	(1.2,3.3)	(-0.9,0.9)	(8.6,9.6)
Couple, with children	**0.8**	6.1	0.2	**-0.5**	0.3	-0.3	3.1
(DP16 estimate)	**(0.3,2.6)**	(10.0,12.0)	(0.5,2.6)	**(-1.5,0.8)**	(-0.8,2.0)	(-1.1,1.9)	(3.1,4.0)
Sole parent	**9.8**	22.4	15.6	**15.2**	14.6	-2.0	-1.7
(DP16 estimate)	**(8.3)**	(15.3)	(13.6)	**(12.8)**	(13.3)	(-2.6)	(-1.7)
All families	***-0.4***	*4.7*	*3.3*	***-0.9***	*-2.1*	*-0.9*	*0.1*
No Demographic Change	***1.0***	*5.0*	*5.5*	***0.8***	*-0.7*	*-0.2*	*0.8*
(DP16 estimate)	*(1.1,2.7)*	*(4.7)*	*(3.7,3.8)*	*(2.3,3.3)*	*(-0.7,1.4)*	*(-0.3,1.8)*	*(1.0,4.0)*

Notes: Farm employed families excluded. The estimates in brackets are from Bradbury, Doyle and Whiteford (1990), Table 10. Where the average weight estimate differs from the spouse weighted result, both estimates are given (the average weight is the lower).

Another example where the re-weighting of this paper seems to be better than that of DP16 is in the estimation of income gains for couples at the lower end of the income distribution. In DP16, changes in wives' participation rates were essentially assumed equal within each age group. However, as has been discussed above, there is clear evidence of association between husbands' and wives' status. This association has been incorporated into the calibration data of this paper. The implication of this is that lower income couples have actually had less of an income increase than previously estimated. This is because wives with husbands unemployed or not in the labour force have not increased their participation to the same extent as wives with higher income husbands (see Table 2).

Over all families, the family type re-weighting method indicates an actual decrease in average incomes over the period. However a large part of this is due to the decrease in couple income units and increase in single adult income units (see page 115 above). This has led to an increase in the number of income units, leading to a drop in average income unit (but not average personal) incomes. When these changes are not incorporated into the weights, the results are more similar to those of DP16, though the average income increase is still less. This may reflect the under-estimate of the decrease in the unemployment rate between 1982–83 and 1988–89 in the simulation compared to that from the LFS. However, the same general conclusions of progressive changes except for the very top of the income distribution still hold.

Whilst these examples generally point to the superiority of the income unit weighting method of this paper to that of DP16, the reasons for the divergence in results for the higher income aged is not so clear. Whilst the large estimated decrease in the 99th percentile of single aged may be a reflection of sample size limitations, the decreases in incomes for high income aged couples is more puzzling. This presumably reflects some change in the weighting of couples with significant employment or investment income and may be a reflection of the fact that the family type reweighting method of this paper does not distinguish couples without dependents by age.

More generally, in considering the validity of these results, it is important to remember that the simulation method used in this paper does clearly suffer from several mis-specifications. Firstly, the matching of labour force experience over the year with aggregate trends is only carried out in a very simple manner. As explained above, this probably leads to an underestimate of the effects of unemployment changes over the period. The impact on the distributional results of Tables 9 and 10 is less clear. One way of validating this (and other) aspects of the weighting method would be to use the *1981–82 Income and Housing Survey* to provide very detailed calibration data on labour force experience by family type. These results could then be compared with the 1981–82 results obtained here. The other main limitation of the adjustment process is that it does not separately disaggregate for different age groups. Some of the implications of this have been indicated in the text. Probably the only way to solve these specification problems will be with the development of multi-vector reweighting methods, though as noted earlier, these have their own difficulties.

Finally, any microsimulation results are always fundamentally constrained by the quality of the base data. Particular caution needs to be used in interpreting results that may depend upon the low recorded incomes of some employed persons. In general such problems of data quality (or perhaps of appropriate data definition) will always be with us. Whilst they may be something of a nuisance in examination of income averages, they are of crucial importance in analysis of the size distribution of incomes. Because of such data 'noise' these estimates of relationship between labour market changes and outcomes for income inequality should be considered lower bounds.

REFERENCES

Atkinson, Anthony B. and Bourguignon, Francois (1987) 'Income distribution and differences in needs' in George R. Feiwel (ed.) *Arrow and the Foundations of Economic Policy*, New York University Press, New York.

Atkinson, Anthony B., Gomulka, J. and Sutherland, H. (1988) 'Grossing up FES data for tax-benefit models' in A. B. Atkinson and H. Sutherland (eds) *Tax-Benefit Models*, ST/ICERD Occasional Paper No. 10, Suntory-Toyota International Centre for Economics and Related Disciplines, London School of Economics and Political Science, London.

Bradbury, B., Doyle, J. and Whiteford P. (1990), *Trends in the Disposable Incomes of Australian Families 1982–83 to 1989–90*, Social Policy Research Centre, Discussion Paper No. 16, University of New South Wales, Kensington.

Bungers, Dieter and Quinke, Hermann (1986), 'A microsimulation model for the German Federal Training Assistance Act - pinciples, problems and experiences' in Guy Orcutt, Joachim Merz and Hermann Quinke (eds) *Microanalytic Simulation Models to Support Social and Financial Policy*, North-Holland, Amsterdam.

Cass, Bettina and Garde, Pauline (1983), 'Unemployment and Family Support' in Adam Graycar (ed.) *Retreat from the Welfare State*, George Allen and Unwin, Sydney.

Chapman, B. J., Dowrick, S. and Junankar, P. N. (1989), *Perspectives on Australian Unemployment: The Impact of Wage Setting Institutions in the 1980s*, Paper prepared for presentation at the Australian Economic Policy Conference, Centre for Economic Policy Research, Australian National University, 27–28 November 1989.

Covick, Owen (1986a) 'Conceptual issues in the measurement of self-employed incomes', in W. J. Merrilees (ed.), *Professional Incomes*, Monograph Series No. 13, Bureau of Labour Market Research, Canberra, AGPS.

Henderson, Ronald F. (1975), *Poverty in Australia*, Commission of Inquiry into Poverty First Main Report, AGPS, Canberra.

King, Anthony (1987a) 'Analysing the distributional consequences of policy: the use of microanalytic simulation methods', *National Economic Review*, 6,7–28.

King, Anthony (1987b), *The Distribution of Current Disposable Income: an Estimation Using Techniques of Microanalytic Simulation*, National Institute of Economic and Industry Research, Working Paper No.1.

Merz, Joachim (1986), 'Structural adjustment in static and dynamic microsimulation models' in Guy Orcutt, Joachim Merz and Hermann Quinke (eds) *Microanalytic Simulation Models to Support Social and Financial Policy*, North-Holland, Amsterdam.

Nolan, B. (1986), 'Unemployment and the size distribution of income', *Economica*, 53, November, 421–45.

Scherer, P.A. (1978), 'The perverse additional worker effect', *Australian Economic Papers*, 17(32).

Sutherland, Holly (1989), *Constructing a Tax-Benefit Model: What Advice Can One Give?* Paper presented at the International Association for Research In Income and Wealth, Twenty-first General Conference, Lahnstein, West Germany, August 20–26.

DISCUSSION

Helen Brownlee
Australian Institute of Family Studies

I'd like to congratulate Bruce on his interesting and informative paper, his rigourous analysis and attention to detail, and his use of some innovative methodology in modelling the impact of labour market changes on the distribution of family incomes. I also found his paper particularly interesting, since at the AIFS we have been looking at refining our own methods of adjusting income survey data and have independently decided to use the same source of calibration data as Bruce has here, that is, the *Labour Force Status and Other Characteristics of Families* survey.

As Bruce clearly points out, any attempt to model the impact of labour market changes necessarily involves some compromises because of the limitations of the calibration data. In the light of this, Bruce has identified three goals of his adjustment process.

Firstly, to identify the labour market states of: not in the labour force, unemployed, part-time employed and full-time employed. I would agree with the importance of this since the relationship between these four labour market states has varied over time. For instance, as Bruce has noted in his paper, there has been a shift towards part-time employment over the 1980s, particularly for married women.

Secondly, to separately identify labour market trends for families with and without dependents. This is quite different from the methodology which Bruce used in DP16, where women were categorized only according to whether or not they were married.

In terms of trends in labour market participation, however, whether or not women have children is far more important than whether they are married or single.

It is important to separate out women with and without children not only because labour market trends may be significantly different for women with and without dependents, but also because the composition of the population may change over time. For instance, in a three year period from June 1985 to June 1989, the percentage of wives who were employed rose by 13 per cent for those without dependents, but by 19 per cent for those with dependents, while the proportion of all wives with dependents fell slightly from 54 per cent to 52 per cent (ABS Cat. No. 6224.0). The components of difference approach allows us to separate out the effect of the change in the composition of the population from the change in rates (see Appendix). Using the components of difference approach shows that between June 1986 and June 1989, for women aged 25–34, the change in the composition of the population, between those with and without children, makes a greater contribution to the change in labour force participation, than the change in the participation rates within in each group. Sixty per cent of the change in labour force participation of married women aged 25–34 over the period was due to the change in composition of the group, as against 40 per cent due to the change in participation rates in each group.

Thirdly, to identify the combined labour market status of husbands and wives:

- because husbands' and wives' labour force status tends to be interrelated and
- because this method provides a better approximation of the income unit weights than if the person weights are adjusted on the basis of changes in individuals' labour force status, and then averaged to obtain income unit weights.

Because of the limitations of the calibration data, if we adopt this particular approach, it is not possible to model *age* as a variable in the impact of labour market changes. The author himself admits that probably the main limitation of this approach is the lack of disaggregation by age 'It is assumed that the labour status trends affect all persons within the income unit equally, whereas there will clearly be differences by age'.

He considers that using the combined labour force status of husband and wife partly solves this problem, by functioning as a rough proxy for age. That is, categorising families according to whether the husband *is* or *is not* in the labour force tends to categorise families according to whether husbands and wives are or are not 'of working age'. I would argue, however, that this only solves the problem in a minor way, since there are important differences in the trends in labour force participation according to age among persons of working age within different income unit types.

Additionally, the composition of the different age groups may vary over time within each income unit type and this may also impact on labour market trends within different income unit types. Bruce touches on this point when he refers to the impact of changing *husbands'* labour force participation.

Thus, for example, in June 1985, of wives with dependent children, the number who were aged 25–34 years was roughly similar to the number aged 35–44 years. Over a period of four years, from June 1985 to June 1989, the percentage of those in the labour force rose by 11 per cent for those aged 25–34 years and 16 per cent for those aged 35–44 years. However, at the same time, the proportion of married mothers aged 25–34 years fell by 5 per cent, while the proportion aged 35–44 increased by 8 per cent. Applying the 'components of difference' method to the data shows that the change in participation rates within each age group has a much stronger effect on changes in labour force participation of married mothers than the effect of the change in the age composition of the population. Ten per cent of the change is due to changes in the age composition, 90 per cent to the change in participation rates within each group. However, we would expect the change in age composition to have a much stronger effect over a longer time period.

Bruce says that he would like to make some adjustment (by age) for single adult income units, but notes that the full four category labour force status categorisation is not available in the published data. However, the full categorisation by age for all persons within income unit types is available from the ABS on special request. It is available on microfiche for the years 1981 onwards.

Differentiating the impact of labour market changes according to age, may well reflect trends in the duration of unemployment, since long-term unemployment has impacted more heavily among those in particular age groups within particular income unit types. Bettina Cass noted in 1988, that the median durations of unemployment varied for different age groups at different stages of working life. (Cass 1988, p. 179).

A further point is that, in adjusting by labour force status, income within each labour force status is assumed to remain constant (the independence assumption). This assumption makes no allowance for the fact that new entrants to the labour market or the newly employed may come from a particular end of the income distribution. As Bruce points out, however, making adjustments by income unit type can lead to changes in the overall distribution of wages. Adding the dimension of age will further alter the distribution. Thus, for instance, as Bruce notes, if we do not make differential adjustments by age, because young single people as a category tend to have both lower incomes and larger unemployment changes, estimates of income changes among single people due to increasing unemployment may be over-estimates. Similarly, if older wives with dependent children experienced greater increases in employment than younger mothers (as occurred between 1985 and 1989), because older wives tend to come from higher income families, estimates of income changes among couples with dependent children may well be underestimates if we do not disaggregate by age.

I am completely in agreement with Bruce that the area where 'the model could most usefully be developed is through disaggregation for different age groups'. However, until the methodology is developed which adjusts the data according to labour force status, sex, income unit type, combined labour force status *and* age, we need to assess very carefully the advantages and disadvantages or incorporating age differentiation in the model. If we are looking at changes over a long time period or updating the 1986 IHS five years ahead and costing policy proposals as we do at the AIFS, differentiation by age is crucial. In these circumstances, one way to overcome to weighting problem temporarily would be to use Bruce's solution (in Discussion Paper No. 16) of applying the spouse's weight to the income unit.

It may well be that adopting each approach, that is, either differentiating by age *or* by combined labour force status of husband and wife, and comparing the different results (as Bruce has done in this paper in comparing results produced by his current model with those produced by the model used in DP16) may assist us to resolve which approach is more appropriate for the *particular* research task in the short-term.

REFERENCE

Cass, B. (1988), *Income Support for the Unemployed in Australia: Towards a More Active System*, Issues Paper No. 4, Social Security Review, Department of Social Security, Canberra.

APPENDIX: THE COMPONENTS OF DIFFERENCE METHOD

Let,

S = Labour force participation rate of all women,

S_c = Labour force participation rate of women with children,

S_n = Labour force participation rate of women without children,

t_c = Proportion of women with children and

t_n = Proportion of women without children.

Then the change in S over time, $\Delta S = S(2) - S(1)$, can be decomposed as,

$$\Delta S \approx \bar{S}_c \Delta t_c + \bar{S}_n \Delta t_n \text{ (effect of change in composition)}$$
$$+ \bar{t}_c \Delta S_c + \bar{t}_n \Delta S_n \text{ (effect of change in rates)}$$

where $\Delta t_c = t_c(2) - t_c(1)$

$\Delta t_n = t_n(2) - t_n(1)$

$\Delta S_c = S_c(2) - S_c(1)$

$\Delta S_n = S_n(2) - S_n(1)$

and

$\bar{S}_c = [S_c(1) + S_c(2)]/2$

$\bar{S}_n = [S_n(1) + S_n(2)]/2$

$\bar{t}_c = [t_c(1) + t_c(2)]/2$

$\bar{t}_n = [t_n(1) + t_n(2)]/2$

MODELLING BEHAVIOUR IN RESPONSE TO TAX CHANGES: THE RATSSS PROJECT

Glenn Jones
School of Economic and Financial Studies,
*Macquarie University**

1. INTRODUCTION

Since the notion of rational optimising behaviour is all that economists have as an evaluative tool, the research project, *Reform of the Australian Tax and Social Security System* (RATSSS), attempts to model tax reforms in a manner consistent with underlying economic theory. Essentially we aim to integrate behaviour with the evaluation of welfare changes.

In the normative public finance tradition, the theory of taxation begins with the specification of the goals of government, which are typically represented as the maximisation of an explicit social welfare function (SWF), defined on cardinally comparable utility levels. The taxed individuals/ households are viewed as maximising a quasi-concave utility function subject to their budget constraints defined by the individual-specific set of prices, wage rates, endowments and the parameters of the tax system. Given a normative specification of the SWF, utility functions and the distribution of budget parameters, it is possible to seek an optimum or at least a welfare improvement. Providing one is willing to make the heroic assumptions required in the search for the optimum, the difference is largely a matter of computing time rather than theoretical difficulty. We focus on the analysis of reforms to the tax and social security systems.

The most general approach in this framework is to treat the problem as one in which the arguments of the utility function are variable so that goods consumptions, labour supplies and savings levels are endogenous choices influenced by the tax parameters. A typically maintained hypothesis for theoretical work on taxation is that the utility function is the same across individuals/ households. Frequently a representative agent, or polar cases of SWF, such as the Benthamite or Rawlsian, might be assumed. In addition, various assumptions can be made about the structure of preferences involved in the model and these frequently enable simplified theoretical solutions. There is also interest in the inversion of this process to ask under what conditions a specific result is implied. For example, it is well established that if the utility function is quasi-homothetic and additive separable then constant rate indirect taxation is efficient, though, even in this case, the social optimality of this policy will depend upon the particular aversion to inequality specified and the distribution of endowments. The same result arises in the simpler case of exogenously fixed labour supply and savings.

Empirical tax modelling using microdata begins with quite a lot of information concerning the actual rather than hypothesised distribution of budget parameters. In contrast to the theoretical tax literature however, much of the modelling of income tax reform avoids making any explicit assumptions about the underlying individual/ household preference structure and proceeds as if income and utility were synonymous. In much of empirical tax analysis, the change in the welfare position is measured by the change in net income, or net cash gain (NCG), and the welfare ranking of individual/ households is measured by gross income (HI). NCG is constructed on the basis that labour supplies are fixed. HI makes no such assumption. In the models used in the RATSSS project we make the underlying preferences explicit and use behaviourally consistent welfare measures.

In the theoretical literature concerning the welfare effects of price changes we have two related approaches based on the utility maximisation paradigm. The compensating variation (CV) and the equivalent variation (EV) measure the change in the cost of the pre- and post-reform utility levels respectively. These two measures are now largely replaced in the literature on welfare measurement by the use of money metric utility: the difference in the cost of achieving the two utility levels measured at either pre- or post-prices (or indeed any strictly positive set of prices). These money metrics have been termed equivalent gain (EG) and compensating gain (CG) by King (1983). The gain and variation measures and the relationship between them are discussed below.

---

* This paper discusses research financed by the Australian Research Council. Their support is gratefully acknowledged.

It is an interesting question to ask what must be assumed about the individual/ household utility function in order to justify NCG and HI as measures of welfare change and welfare ordering. In the standard case in which the agent maximises a strictly quasi-concave utility function defined on aggregate consumption and leisure, neither NCG nor HI are consistent with utility maximisation. Money metrics of change in welfare caused by a tax reform will depend upon the prices and net wages individuals/ households face and on the parameters of the utility function. Only with min (or Leontief) preferences do NCG and HI provide utility consistent measures. However min preferences cannot be consistent with fixed labour supply or with the observation that two individuals with differing labour supplies at the same income have the same welfare level. Under these circumstances a lexicographic preference ordering is implied and no utility function then exists. With min preferences HI can be considered a money metric welfare ordering equivalent to King's equivalent income, since it makes no fixed labour supply assumptions. However, min preferences are not likely to fit the data very well since a large part of the sample will have the same labour supply but different wage rates. Given that min preferences are unlikely to be very useful in generating the observed data then perhaps welfare measures implicitly based on this premise need stronger justification than the usual defence that they provide a 'snapshot' view.

In the empirical analysis on which our tax simulations are based, we adopt flexible specifications of behaviour, to minimise restrictions imposed on the data by the functional form. This is important because behavioural changes in response to taxation have important consequences for welfare measures, equity-efficiency trade-offs and the macroeconomy. A model that implicitly fixes labour supply or restricts the range of elasticity responses is not likely to estimate revenue changes very well nor is it likely to answer important questions concerning changes in behaviour such as labour force participation or savings behaviour. Of course for predictive purposes the modelling of these gross effects need not be utility consistent but because of the complex nature of individual budget sets, the predictive power of labour supply models is likely to be enhanced by adhering to utility consistency at the estimation stage. Where this implies the necessity for restrictions, there is a standard econometric framework for testing their adequacy. If the cost in terms of fit is deemed too high then one might resort to non utility maximising estimates of revenue and gross changes but this is not possible where exact efficiency measures are required.

An extremely important focus for the analysis of tax reforms in the RATSSS project has been the way in which behavioural changes in response to tax changes will give rise to excess burdens. Min preferences must estimate these excess burdens as zero and thereby limit the discussion of tax reform to a 'snapshot' of the distributional impact alone. There have been attempts to estimate excess burdens by resort to calculations of Harberger triangles using compensated labour supply elasticities selected from the literature and to estimate changes in net earnings using gross elasticities. Not only are they likely to be inconsistent with each other, they are also likely to be inconsistent with the data to which they are applied. Even if it were possible to define a preference specification which imposed the same gross and compensated elasticity on all data points, the resulting specification is likely to be extremely inflexible and such forms are generally rejected by specification tests when compared with less restrictive forms. The only way of resolving this difficulty is to estimate a flexible utility consistent behavioural model on the data used for the tax analysis and this is the procedure we adopt.

2. BEHAVIOURALLY CONSISTENT TAX ANALYSIS

Provided we accept utility maximisation, the theory of duality applied to labour supply allows us to link price and income changes to unobserved welfare changes which are fundamental both to the distributional and efficiency aspects of tax reform evaluation. If the integrability conditions required of a system of Marshallian demands are satisfied, the estimated parameters are also the parameters of some underlying indirect utility function (see Hurwicz and Uzawa, 1971). We can thus move between Marshallian demands and a utility index.

The simplest way of assuring this and producing tractable forms for estimation is to begin with the specification of an indirect utility function or a cost function. Utility maximisation enforces specific properties on these functions. The indirect utility function must be homogeneous of degree zero in prices and incomes, non-decreasing in income and non-decreasing and quasi-convex in prices. The cost function must be non-negative, homogeneous of degree one in prices, non-decreasing in utility and non-decreasing and concave in prices. All that is required is to ensure these properties are satisfied by the particular model chosen to represent the cost and indirect utility function.

There are two results in the theory of duality which yield integrable demand/labour supply systems from either of these functions. The first is to apply the Roy (1942) theorem to yield Marshallian demand functions from the indirect utility function. The second is to apply the Shephard (1953) result to obtain the Hicksian demand functions from the cost function and then substitute in the indirect utility function to arrive at the Marshallian demands. The system of Marshallian demand functions thus obtained will satisfy certain of the integrability conditions, notably adding up, homogeneity of degree zero in prices and income and Slutsky symmetry provided the appropriate restrictions are imposed on the estimated parameters. While it is possible to directly impose negativity of the Slutsky matrix at the estimation stage, when the system is relatively complex, it is more common to check for concavity of the cost function at each data point prior to simulation. We follow the latter procedure.

Since the parameters of the estimated demand functions are simultaneously the parameters of the indirect utility function and the cost function, changes in prices and incomes caused by a tax reform and the associated behavioural changes may be directly related to changes in a specific utility index or to changes in the dollar value money metrics. In addition they may be used to obtain a measure of the welfare positions of individuals/ households pre-reform and this provides an appropriate welfare ordering. The comparison of the measures explicitly relies on cardinal comparability recognising that the measures are conditioned by the specific functional form as well as the data. Equivalent income in the absence of taxation could in principle be calculated (corresponding to the use of gross income) but the determination of welfare change would then become a comparison in two stages, of the pre- and post-reform regimes, to the untaxed regime.

In summary our method of analysing the distributional and efficiency effects of a tax reform is to specify and estimate a set of utility consistent Marshallian demands and to use the estimated parameters to derive a welfare ordering of households in the pre-reform position. The system provides the means by which to predict the post-reform set of demands and the welfare changes for each individual/ household. Finally we calculate the aggregate efficiency cost and overall social welfare implications of the reform for a range of aversions to vertical and horizontal inequality.

Equivalent incomes pre- and post-reform are defined as the levels of income which yield each household's pre- and post-reform utilities, were they to face a hypothetical set of reference prices and wages which are held constant for all households. They indicate the amount of income needed, if the household faced reference prices and wages, to be equally well off as with its actual prices and wages.

In deriving the money metric welfare ordering, constant reference prices are necessary to ensure that we are obtaining consistent measures of the distances between households' utilities. Denoting the indirect utility function by v, for each household we have

$$v(p^r,w^r,YE) = v(p,w,Y)$$

where YE is equivalent income, p^r is the price of aggregate consumption, w^r is the vector of reference wage rates and non-superscripted arguments denote actual quantities. The equivalent income function is a monotonic transform of the indirect utility function and some properties of the indirect utility function (or the corresponding cost function) are preserved in the equivalent income function: it is increasing in reference prices and income, and decreasing and concave in actual prices. We use the equivalent income derived using each individual/ household's actual pre-reform prices and net wages to provide the welfare ordering used to determine the distributional impact of tax reforms.

The use of constant reference prices to derive the money metric welfare ordering is illustrated in Figure 1 for two individuals with different budget sets. Y^1 and Y^2 are the linearised full incomes of persons 1 and 2 respectively. Their observed gross incomes are given by G^1 and G^2 and their net incomes by M^1 and M^2. Equivalent incomes are YE^1 and YE^2. The reference wage rate used in the diagram is w^1, the higher net wage. Although the observed incomes of the two individuals are close, their full incomes are considerably different. From the diagram it can be seen that the difference in full incomes is reduced when equivalent incomes, which take account of the form of preferences, are used.

For the same reasons that measured income is an unsatisfactory measure of welfare position, the simple difference between net income ante reform and post reform (assuming no behavioural response), M^0-M^1 in Figure 2, is undesirable as a measure of welfare change. A utility based measure is provided by each household's equivalent gain, EG.

Figure 1

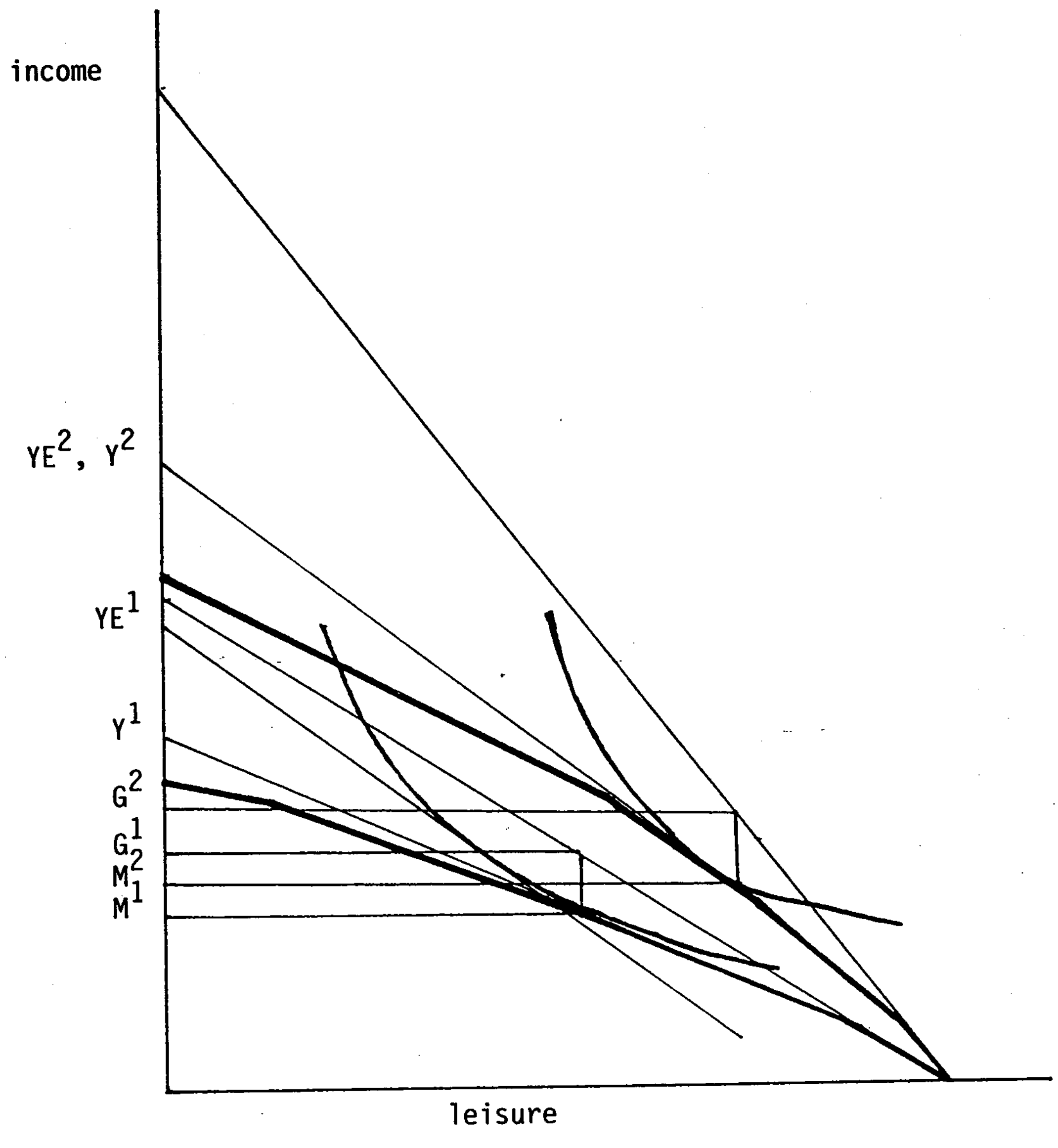
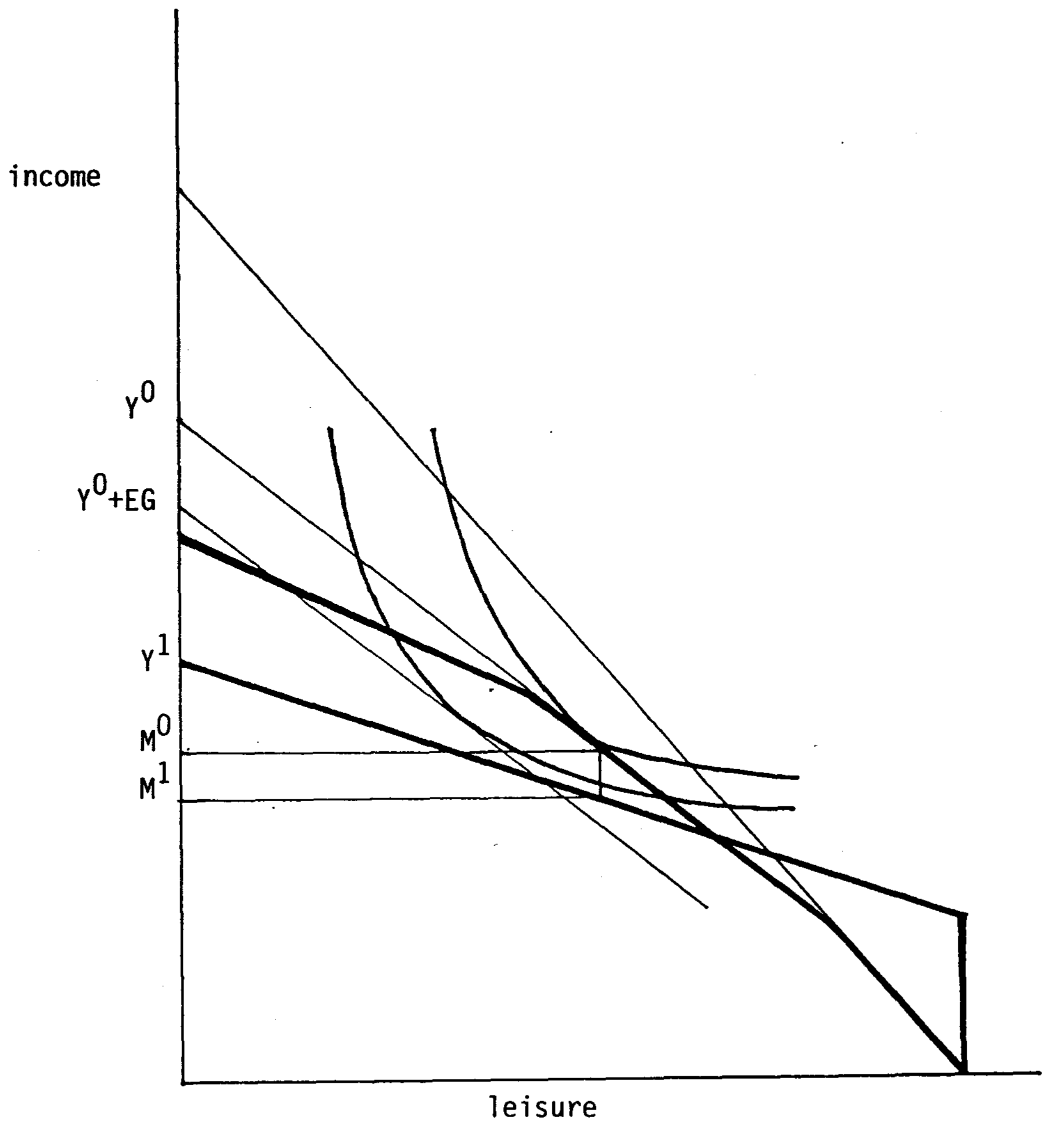


Figure 2



The EG resulting from some reform induced change in prices and income, is defined as the increment to pre-reform full income required to achieve the post reform utility level. In this case the reference is each household's ante prices and wages. Thus, we have

$$v(p^0,w^0,Y^0+EG) = v(p^1,w^1,Y^1)$$

In Figure 2 the EG for an individual is illustrated for a reform involving a move from a system of progressive marginal rates to a guaranteed minimum income equal to the existing threshold, financed by an increased marginal tax rate. Full incomes before and after the reform are Y^0 and Y^1 respectively. The EG may be expressed more concisely using the cost function as

$$EG = c(p^0,w^0,u^1) - c(p^0,w^0,u^0)$$

and is shown by the distance $Y^0-(Y^0+EG)$.

The EG is a measure of change in welfare which uses household specific initial prices and net wages as reference prices. Some manipulation reveals a simple relationship between this concept and the familiar equivalent variation

$$EV = c(p^1,w^1,u^1) - c(p^0,w^0,u^1)$$

Combining the two gives

$$EV = \Sigma - EG + Y$$

For revenue neutral tax reforms the excess burden (EB) in terms of EG's may be written as

$$EB = - \Sigma\, EG$$

The advantages of welfare measures based on original prices over those based on induced prices (compensating gains) are well established. However, despite the intuitive appeal of using each household's own prices and net wages to determine its welfare change, the problem remains that different prices and net wages are being used across the sample. An alternative measure which uses the same set of references across all decision-makers is the change in equivalent income, DYE. This measure has some appeal if welfare changes of individual agents are to be aggregated. We present both EG's and DYE's by equivalent incomes in our distributional analyses.

3. FUNCTIONAL FORM

Not all integrable demand system specifications are appropriate for tax analysis. If we wish to undertake a welfare analysis of the kind outlined above the specification of the estimated equations cannot be arbitrarily selected. The functional form of estimated demand systems has been a major concern particularly where the models are used for policy simulation. The specification of preferences in the indirect utility function must be sufficiently flexible to capture the behavioural responses and cross effects inherent in the data set on which the model is estimated. It is for this reason commonly used functional forms such as the Linear Expenditure System or the Constant Elasticity of Substitution specification are inadequate for tax analysis and interest has focused on functions in which second (and sometimes third) order Taylor expansions of prices and incomes are used to capture the arbitrary true function.

In our work we have concentrated on the Almost Ideal Demand System (AIDS) (Deaton and Muellbauer, 1980). This is a flexible specification in that the cost function contains a second order Taylor expansion of prices and wages. It has an indirect utility function of the form

$$v(p,w,Y) = \log (Y/a(p,w)) / b(p,w)$$

where p is the price of a composite consumption good, taken to be unity in cross section data, w is the net wage rate vector and Y is virtual full income. The price index a(p,w) is translog in form and is given by

$$a(p,w) = \alpha_0 + \Sigma\, \alpha_i \log w_i + \Sigma_i\Sigma_j\theta_{ij}\log w_i \log w_j + \beta(\log y - a(p, w))$$

and the price index b(p,w) is Cobb-Douglas in form given by

$$b(p,w) = \Pi_i\, w_i^{b_i}$$

The equivalent income function is given by

$$YE = \exp[\, \Pi_i \, w_i^{\beta_i} u + a(p^r, w^r) \,]$$

The AIDS indirect utility function is strictly concave in full income and if this property is to be preserved globally in the equivalent income function, the reference prices and net wages chosen should be at least the maximum or at most the minimum of actual prices and net wages depending upon whether the good is a necessity or luxury respectively. The estimated set of Marshallian demands in share form are given by

$$s_i = \alpha_i + \Sigma\, \theta_j \log w_j + \beta_i(\log Y/a(p,w))$$

We directly impose adding up, symmetry and homogeneity on the estimated Marshallian demands and we include demographic characteristics for household size and the age composition of dependents into the constants and/or income parameters of the system. Thus equivalence between households is integrated into the model in a relatively simple and systematic manner.

The use of demographics presents some problems of interpretation for the subsequent welfare analysis since the implied preferences capture the effects of household composition non-separable from consumption and labour supply but any separable direct effects cannot be known. The direct, and presumably positive, impact of children on utility is not modelled, the methodology taking account only of the costs associated with children. Two otherwise identical households one of whom chooses to spend a given portion of their budget on increased personal consumption of goods and the other on children, are necessarily placed at different positions in the welfare ordering, and it will generally be the case that the goods consumer will be at a higher utility position. The procedure derives information on the relative costs associated with children but may understate the welfare positions of child choosing households. The number of children acts like a shift parameter in the utility function explaining taste variation across households. Where welfare levels are compared, the equivalent incomes are compared at constant reference household demographics.

4. DECISION VARIABLES, ESTIMATION AND SIMULATION

There have been a variety of approaches to modelling household labour supply decisions, the structure of the estimated model being influenced by the maintained hypotheses about the constraints on household choice. Atkinson and Stern (1980) model variable male labour supply with female labour supply fixed. Rosen (1976) and Arrufat and Zabalza (1986) estimate a variable female labour supply with husband's income fixed. This latter model is referred to as the male chauvinist model. Obviously a single equation chauvinist model has advantages for estimation.

For the majority of our work so far we have concentrated on married couple income units and used a full household model in which the household allocates two leisures and joint goods consumption. The aggregate consumption expenditure is identified by the adding up restriction on the system. We have as well estimated a male (and female) chauvinist model for both household members and single individuals.

Estimation requires reconstructing the budget sets of individual households in order to obtain net wages and full incomes. In the joint model the income term is the sum of individual time endowments valued at the net wage and the appropriate virtual income extension. In the chauvinist models individual full income is supplemented by the earned income of the partner (where one exists) and the partner's wage is omitted as an explanatory variable. This procedure is equivalent to treating each labour supply as a rationed separable good.

When the budget boundary is piecewise linear, the net wage is endogenised through the labour supply decision. In estimation it is usual to ignore all segments of the budget constraint other than the one on which the individual is observed. This procedure leads to biased estimates because of the endogeneity and it also represents a mispecification of the problem since the errors in the regression equation imply that it is possible for individuals to be on budget segments other than the one observed. The appropriate estimation technique is to search for an optimum consistent with the budget constraint for each individual. In the cases where kinks are the predicted optimum the process is more complicated. In the welfare analysis of the tax simulations a virtual wage and income that would support the kink as a utility maximising choice need to be found. With two labour supplies, the kinks correspond to the edges and points of the polyhedron. At points both sets of virtual wages and incomes must be found while at edges one wage is fixed and only one virtual set needs to be found. These virtual wages will exist and be positive provided the cost function underlying the labour supply functions is concave at the point.

With flexible functional forms the degree of concavity violation generally increases with the number of goods modelled. A closed form for the virtual wage will speed the procedure but with flexible forms an iterative procedure is required. With convex budget sets appropriate bounds can be set on the search procedure for the virtual wages but even with this restriction when two labour supplies are allowed to vary the procedure is computationally time consuming. If the budget set is convex then search for the optimum need only exploit the labour supply function.

The estimation task is considerably simplified if it is assumed that the underlying utility function is non-stochastic with all variation in preferences captured by the presence of the demographic variables in the utility specification. Any other sources of variation are assumed to arise from either measurement error in the dependent variable or from optimisation error on the part of the household. An alternative estimation procedure is to view households as having stochastic preferences. With complicated functional forms this procedure becomes almost intractable.

The estimation is further complicated by a significant number of non-participating married women. This is frequently handled via the Heckman two stage procedure which corrects for the sample selectivity bias resulting from the estimation of the model on a sample of participating women. However this approach is inconsistent with the non-linear AIDS specification and we use a single stage Tobit procedure to deal with the truncation at zero hours.

For the reasons outlined above, the system is estimated using maximum likelihood under the assumption of non-stochastic preferences. We have limited our estimation to data points outside the social security system because the associated non-convexities in the budget set would require even more extensive search techniques to evaluate the utility maximising positions on a series of convex subsets of the non-convex budget set. Where the direct utility function is not available, this requires the calculation of virtual wages and incomes for a significantly higher proportion of the sample.

If we believe that the relative fixity of male hours arises by constraint in the labour market then this is capable of being handled within a utility consistent framework via the theory of rationing (see Neary and Roberts, 1980; Deaton and Muellbauer, 1981). Under rationing the wage which would induce the ration point is an argument of the estimated form. Linear specifications of the Marshallian demands have an advantage in that it may be substituted out and in the remaining labour supply function the relevant income term is the sum of household non-labour income and the labour earnings of the rationed spouse.

An important reason for the simplification of the model via the dropping of one labour supply is clearly ease of estimation. This implies rationing the labour supply of one household member. However non-linear forms do not ration easily since there is no closed form for the shadow wage and intercept income supporting the ration point. Iterative means must be used to solve for the shadow wage and the estimation burden is then significantly higher than the estimation of unrationed two equation models. Restrictions to linear and or separable forms are likely to place unnecessary restriction on the estimation and may significantly restrict the results. So we have treated all labour supplies as freely variable.

In the simulation stage of the analysis the estimated model is first used to derive the stochastic components for each household in the data period. If the base period for simulation differs from the data collection period the model is used to predict the base set of demands and the pre-reform welfare ordering. This involves searching along the segments of each household's budget constraint to find the utility maximising choice in the base period. An appropriate search algorithm checks each budget constraint segment, defined by its wage and virtual intercept income, for a consistent labour supply prediction and terminates when one is found. All predictions must be on feasible parts of the budget set.

Predictions are then derived for the reformed tax system using the same search algorithm. When required, revenue neutrality is achieved iteratively in the simulation procedure. We have three possible specifications of returning the implied deficits or surpluses arising from the reforms simulated. We may not give the revenue back at all, or return it in a lump sum to each household or by means of a constant marginal tax rate adjustment (including or excluding the tax threshold). The method chosen for distributing the revenue has equity and efficiency implications for the results of the tax reform.

Once the set of post-reform demands is determined, the measures of welfare change (EG and DYE) are calculated and the distributional analysis is undertaken. This analysis may be compared with the fixed incidence analysis. The final stage is to derive measures of change in the excess burden and the social gain associated with the reform. This makes explicit any equity-efficiency trade-offs involved. We present the welfare analyses of tax options for a range of normative judgements concerning inequality.

To date we have concentrated on reforms to the income tax system and to transfer payments relating to children. We intend to integrate savings and labour supply distortions into our analyses when appropriate unit record data becomes available.

REFERENCES

Arrufat, J.L. and A. Zabalza (1986), 'Female labour supply with taxation, random preferences and optimisation errors', *Econometrica*, 54, 47-63.

Atkinson, A.B. and N.H. Stern (1980), 'On the switch from direct to indirect taxation', *Journal of Public Economics*, 14,195-224.

Deaton, A. and J.M. Muellbauer (1980), 'An almost ideal demand system', *American Economic Review*, 70, 12-26.

Deaton, A. and J.M. Muellbauer (1981), 'Functional forms for labour supply and commodity demands with and without quantity restrictions', *Econometrica*, 49, 1521-32

Hurwicz, L. and H. Uzawa (1971), 'On the integrability of demand functions', in Chipman et al. (eds), *Preferences, Utility and Demand*, Harcourt-Brace, New York.

King, M.A. (1983), 'Welfare analysis of tax reforms using household data', *Journal of Public Economics*, 21, 183-214.

Neary, J.P. and K.W.S. Roberts (1980), 'The theory of household behaviour under rationing', *European Economic Review*, 13, 25-42.

Rosen, H.S. (1976), 'A methodology for evaluating tax reform proposals', *Journal of Public Economics*, 6, 105-21.

Roy, R. (1942), *De l'utilite: Contribution a la Theorie des Choix*, Hermann, Paris.

Shephard, R.W. (1953), *Cost and Production Functions*, Princeton University Press, Princeton.

DISCUSSION

Russell Ross
Social Policy Research Centre
University of NSW

In drawing up my comments, I'm mindful of the fact that in the past the RATSSS project has been commented on by many others, so I'm unlikely to offer any new technical insights. I've approached my task from the viewpoint of someone competent in microeconomics, with a strong interest in the labour market, and a keen interest in computer-based economic analysis. My comments and questions are divided into two types: broad issues, and nuts and bolts technical issues. I'll address the technical ones first.

Nuts and Bolts

There is a lot of discussion of the underlying theory upon which the model is based, and I have no qualms about that theory. However, there is no detail as to how the model is actually estimated. For example,

- How many equations are in the model?
- What assumptions are made about the labour supply elasticities? Are they the same for males and females. Are they demographic-specific?
- Is the income elasticity of demand for the composite consumption good set to unity? Or are savings allowed for in this model?
- Can the model accommodate any disaggregation on the demand side? For example, can the model say anything about indirect tax reforms such as the introduction of a broad-based consumption tax?
- Has any sensitivity analysis been undertaken to see if the AIDS (Almost Ideal Demand System) is the most appropriate system to use in the Australian context?
- How suitable is this model for testing fine-tuning reforms to the tax system, or is it suitable only for assessing large scale reforms?

Broader Issues

One of the strengths of the RATSSS Project is that it is different to the other Australian micro-simulation research projects. As Peter Saunders has pointed out, whereas other researchers take a data base and simulate changes over time, the RATSSS project has a different focus. Its emphasis is to simulate different tax/social security regimes at a point in time.

In the written version of his paper, Glenn mentions the critical need for the continued production of Unit Record Files as a research tool for this type of work. After the period of 'ABS bashing' in today's initial session, the issue of unit record tapes seems to have faded away. This is a theme to which I'd like to add my voice, if only to remind us all that it is not only microsimulation work which requires on-going access to unit record tapes. There is a wide range of economic and social issues for which research requires the availability of unit record tapes. Indeed, I'd go a step further and argue that the debate shouldn't be about cutting the availability of these tapes, but in fact giving consideration to expending their availability towards the provision of a longitudinal data base on which is a comprehensive set of information on individual and household incomes and expenditures.

My final comment is perhaps the most pertinent. At the end of the (research) day, how useful is the RATSSS model as a tool for analysing proposed reforms to the taxation and social security systems? It is a question to which I do not have an immediate answer, but it is one which is clearly relevant.

SUMMARY OF GENERAL DISCUSSION[1]

A range of issues were raised by participants during the discussion which followed each paper and the general discussion at the end of the day.

AVAILABILITY OF DATA

Participants were acutely aware of current data constraints and also expressed concern that the ABS may not release the unit record tapes in the future. Not surprisingly, a considerable proportion of discussion time was spent on the related issues of privacy and access to data, the integration of data bases and the extension of data coverage.

It was noted that the question of access is not only an ABS problem, but in fact all institutions and organisations are bound by privacy or confidentiality requirements. Given these restrictions and the implications for the availability of data a number of possible 'solutions' were canvassed. These included:

a) Creating a synthetic unit record derived from the integration of data from different sources. According to the ABS, such an approach has been adopted by Statistics Canada.

b) Adopting the Luxembourg Income Study approach. Access to the unit record tape would be permitted but only within a 'controlled environment' i.e. program files would be submitted to the ABS for approval and execution, using the Bureau's computing facilities. The ABS is currently examining this option.

c) Adopting the 'enclave' approach. This would be similar to the Luxembourg Income Study approach except that researchers would be temporarily attached to the ABS although externally funded.

There was mixed reaction to these approaches. Although financial and legal constraints were acknowledged some participants were concerned by the direction the ABS appeared to be taking. There was also confusion surrounding the difference between the creation of a synthetic unit record tape on the one hand and the integration of data from different sources on the other. It was suggested that Statistics Canada had used its complete unit record file and randomised it, thus confidentialising it, to produce a synthetic file. The integration of various data bases, however, involved synthetic merging, a process with which there were 'massive' problems, both statistical and interpretative. Another participant noted, however, that the *systematic* creation of an integrated data base which, despite its synthetic nature, contained a broad range of information had value in its own right.

The absence of adequate financial (e.g. assets and wealth) and longitudinal data was noted by a number of participants and the pursuit of alternative data sources to ABS suggested. There were expressions of support for setting up a panel study in Australia, independently of the ABS, with funding to be sought from the Australia Research Council. There was strong support for continuing dialogue between the ABS and users to develop principles and solutions that would permit access to much needed data.

RESPONSES TO PAPERS

Reservations were expressed about the perceived limitations of dynamic modelling. It was argued that while static modelling simulates a cross-sectional survey, the dynamic approach simulates panel or longitudinal surveys. Consequently, one advantage of the static approach is that other cross-sectional surveys exist which can be used to calibrate the data. The disadvantage of dynamic modelling was that panel data does not exist against which it can be calibrated. This was thought to be problematic, for example, when estimating transition probabilities. Overall, however, it was noted that current research on dynamic modelling and its obvious potential may in fact provide the necessary stimulus for the collection of panel data, one participant arguing that dynamic simulation could do anything that static simulation could do and more.

---

[1] Prepared by Jenny Doyle, with assistance from George Matheson, Marina Paxman and David Pearl.

Following Bruce Bradbury's paper, discussion focussed on the issue of re-weighting and the problematic nature of independence in calibration sources. It was suggested that whilst the weights for individuals in ABS surveys were calibrated against census data, this was not the case for family or household weights—leading to some uncertainty about their reliability and independence.

Discussion canvassed the issue of the accuracy of figures produced from microsimulation modelling. Statistical errors, measurement errors, and calculation errors are areas where the potential for inaccuracy may increase with 'number crunching'. The extent of error and the accuracy of the figures must be considered, it was argued, when developing microsimulation models and interpreting the results generated. The discussion also focussed on a more specific point, namely the large changes over time in the gini coefficients for income distribution within each family type which feature in Table 9 of Mr Bradbury's paper. One possible explanation for these large changes was thought to be that the results were only intended to show the effect of change in labour force status when in reality this effect may be offset by other factors. Mr Bradbury responded by noting that a large component of these changes reflected the impact of increases in the labour force participation of married women. As a result, it was not possible to draw simple conclusions about changes in the distribution of economic welfare from this information on income distributions.[2]

Many issues were raised following Dr. Glenn Jones' paper and revealed, in particular, the almost diametrically opposed nature of the concerns of, on the one hand, theoretical microeconomists and on the other, microsimulation modellers. Whilst the latter usually take economic scenarios as given and simulate across time, the former freeze time and simulate the economic processes at work. Greater availability of longitudinal data—for example, on individual savings behaviour through time—may help bridge this gap.

Another point raised was that the microeconomic approach appears best suited to analyse 'large' changes in the tax system and as such, fail to give us an adequate idea of the likely effects of (more relevant) 'small' or marginal changes—changes that are more germane to actual policy debates.

GENERAL DISCUSSION

This covered mainly what the various departments and organisations represented were doing in this area. Despite the extensive overseas use of microsimulation methods for policy costing and analysis, Australian government departments were mainly using very simple methods. The main exception is the Australian Taxation Office which has a database on taxation-related areas, although Mr Wilson was unaware of any requests for access to this information to simulate new tax regimes or expenditure patterns. A Department of Finance representative confessed that they were 'down to their last box of envelopes'. Finance does have a database on AUSTUDY recipients holding information on family incomes and related matters. The Treasury has no integrated modelling procedures as such.

On the issue of data availability, the AIFS has data on wealth holdings from their divorce study; these have been lodged with the Social Science Data Archives.

2 Editors Note: Unfortunately these interesting gini coefficients proved to be an (inadvertent) demonstration of my dictum that 'if it's interesting it's probably wrong'. The correct coefficients are now shown in the table.

LIST OF PARTICIPANTS

PRESENTERS AND DISCUSSANTS

Professor Bruce Bacon, Centre of Policy Studies, Monash University and Centre for Federal Financial Relations, Australian National University.

Mr Bruce Bradbury, Social Policy Research Centre.

Ms Helen Brownlee, Australian Institute of Family Studies.

Mr Will Foster, National Institute of Economic and Industry Research.

Mr Phil Gallagher, Department of Social Security.

Dr Otto Hellwig, National Institute of Economic and Industry Research.

Dr Glenn Jones, School of Economic and Financial Studies, Macquarie University.

Mr Anthony King, National Institute of Economic and Industrial Research.

Dr Ian Manning, National Institute of Economic and Industry Research.

Dr Russell Ross, Social Policy Research Centre.

Dr Peter Saunders, Social Policy Research Centre.

Dr Neil Warren, School of Economics, University of NSW.

OTHER PARTICIPANTS

Mr Keith Blackburn, Australian Bureau of Statistics.

Mr Richard Cumpston, Institute of Applied Economic and Social Research.

Ms Jenny Doyle, Social Policy Research Centre.

Mr George Gondor, Australian Institute of Family Studies.

Mr Ervin Grecl, Department of Social Security.

Mr Chris Foster, Department of Social Security.

Mr Bob Harrison, Australian Bureau of Statistics.

Mr James Jordan, Department of Finance.

Mr Simon Lambert, Department of Social Security.

Mr George Matheson, Social Policy Research Centre.

Mr Brad McDonald, Department of Finance.

Dr Peter McDonald, Australian Institute of Family Studies.

Mr Ken Oliver, Department of Social Security.

Ms Marina Paxman, Social Policy Research Centre.

Ms Sue Roald, Treasury.

Mr David Pearl, Social Policy Research Centre.

Ms Diane Thompson, Department of Social Security.

Dr Elizabeth Savage, Sydney University.

Mr Peter Whiteford, Social Policy Research Centre.

Mr Adrian Wilson, Australian Taxation Office.